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THE ENGINEERING CONSTRUCTION WEEKLY

ENGINEERING NEWS-RECORD

MARCH 16, 1939

Sardis Dam on the Little Tallahatchie River in Mississippi

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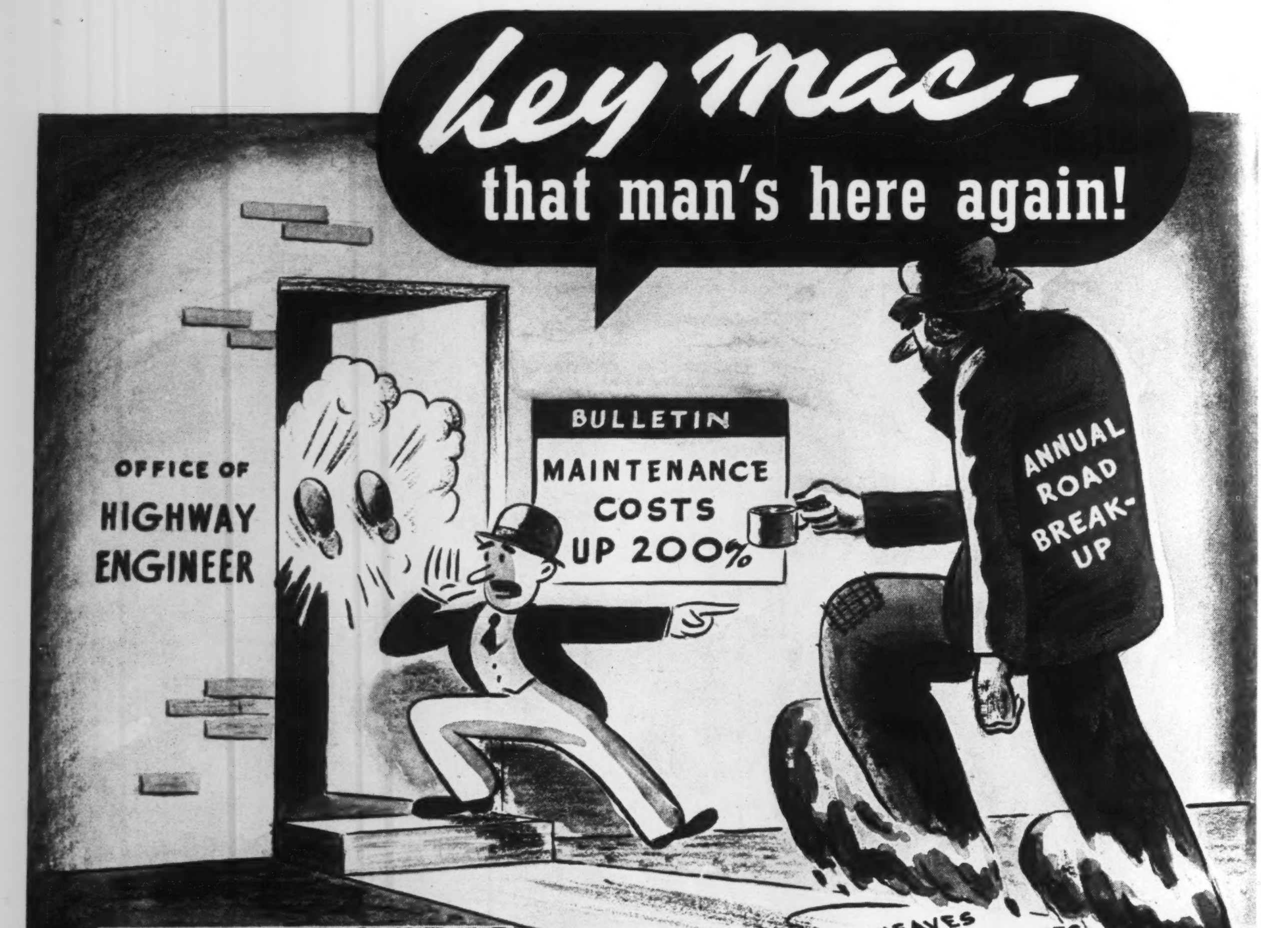
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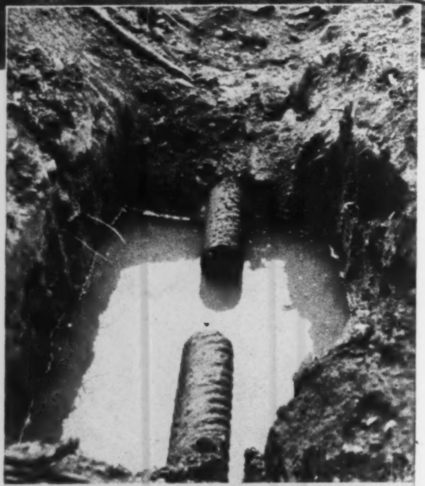

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THIS WEEK

- Sardis Dam is a pioneer in at least two ways: it is the first of several flood-control dams listed in the revised Lower-Mississippi flood-control plan, and it is a full-scale experiment in the use of delta soils for hydraulic fill.

- Virginia Beach, the resort near Norfolk, has a summer population that is sometimes as large as 40,000. How engineers designed a sewage disposal plant to care for the maximum summer population as well as for a winter minimum of 2,500 is told on page 47.

- Public relations again take their share of attention in *News-Record's* columns in the article "Selling Good Will with Good Water." This time it's from the viewpoint of the privately-owned public utility.

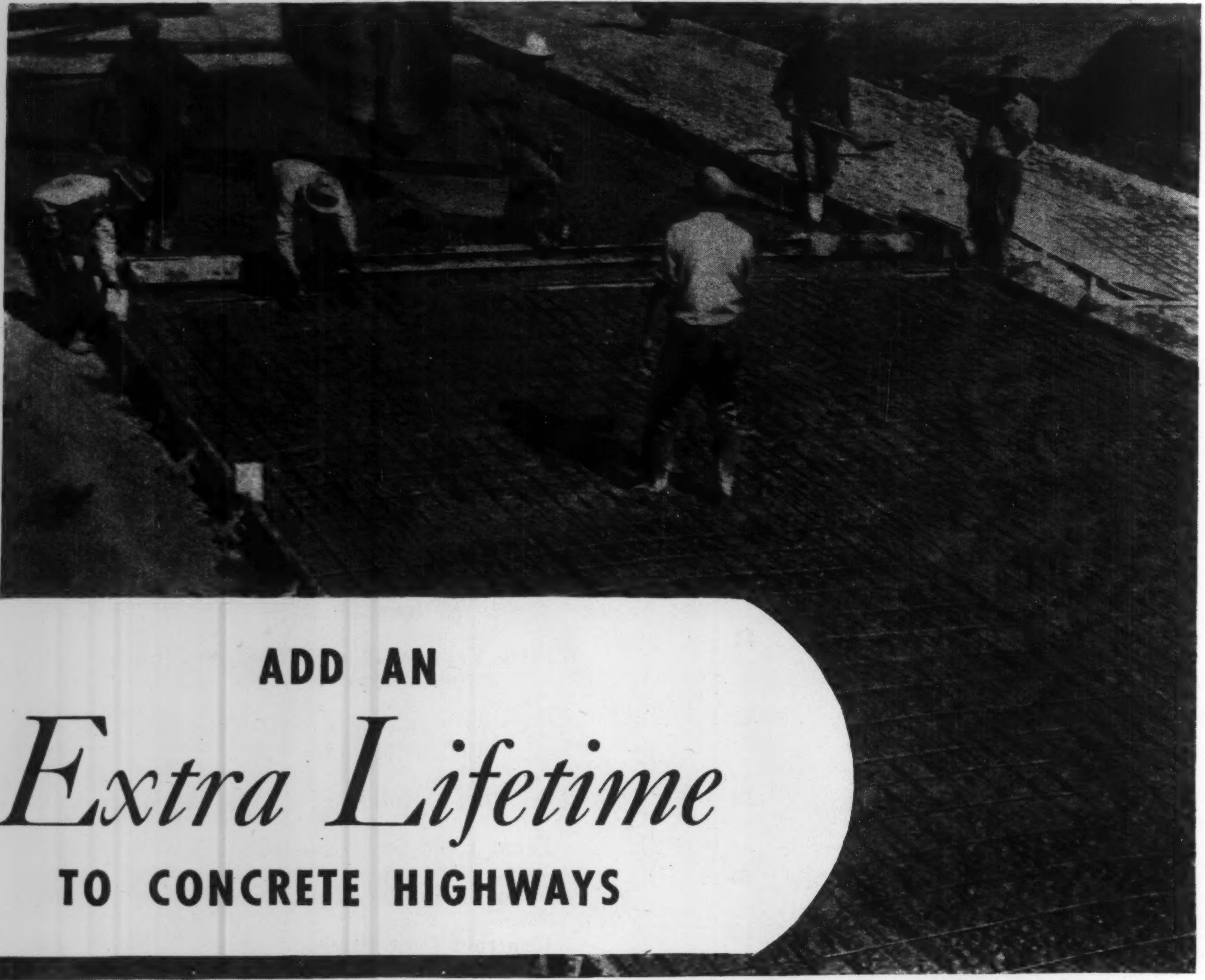
- An engineer touches his torch to the unit price question—a subject that may be an inflammable heap of controversy.

THINGS TO COME

PUBLIC RELATIONS in engineering will come in for some more attention in the next news-technical number, March 30. Beginning with the statement that engineers are probably the most inarticulate class of top-flight intelligents, Clifford Mosier of the *Charleston* (W. Va.) *Gazette* tells why an engineer should use public relations counsel as he would use legal and medical counsel.

BEGUN TEN YEARS AGO as an emergency measure to provide design data on Boulder Dam, the experimental laboratory of the U. S. Bureau of Reclamation at Denver is now a vital routine design tool. Its story is scheduled for March 30.

THAT ISSUE will also include abstracts of a number of the papers given at the San Francisco road meetings reported in the news-pages of this issue.



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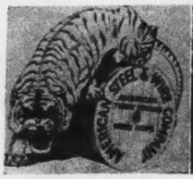
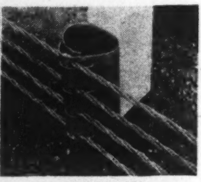
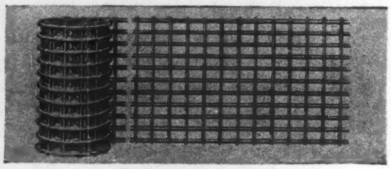


AMERICAN TIGER BRAND WIRE ROPE



MULTISAFTY CABLE HIGHWAY GUARD



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NEWS
ENGINEERING NEWS-RECORD

Volume 122 MARCH 16, 1939 Number 11

Yellowstone Compact Extension Urged

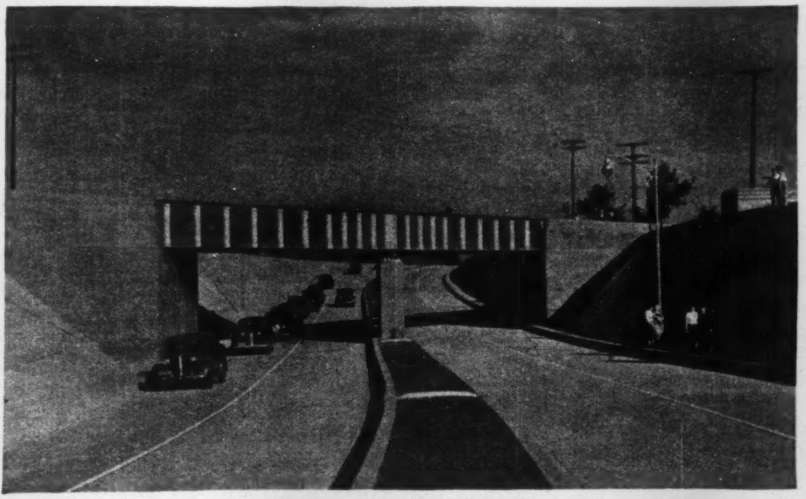
Modification of a Congressional act of 1937, which permits Montana and Wyoming to negotiate a compact apportioning the waters of the Yellowstone River, is urged in a report to Congress made by Clyde L. Seavey, representative of the United States on the commission negotiating the compact. Commissioner Seavey recommends that the act be amended to include the State of North Dakota in the negotiations and that the time limit on the negotiations, now set at June 1, 1939, he extended indefinitely.

In his progress report, Seavey points out that much of the information necessary for the negotiation of a compact is not now available and more time is needed. Investigations so far made indicate that apparently the annual runoff for the Yellowstone Basin would be sufficient to meet all requirements if a comprehensive storage plan were put into effect. At present, however, water supplies are inadequate to meet the demand in dry years.

• • •

Washington Passes Housing Act

Enabling legislation permitting municipalities in the State of Washington to set up local housing authorities was passed this month, bringing to 34 the number of states which have such laws on their books. Authorities have been set up in all but two of these states and there are now, according to the National Association of Housing Officials, 225 local housing authorities in operation.



GROUNDWATER OVERCOME IN UNDERPASS CONSTRUCTION

Dedication late last month of this $265,000 underpass, built by the California Division of Highways under the Southern Pacific R. R. at Livingston, Calif., was made possible by overcoming serious groundwater difficulties. Preliminary investigation showed that groundwater would rise to within 16 ft. of the rails, whereas the roadway surface at the low point is 20 ft. below the rails. To prevent uplift action, the pavement was made 3 ft. thick at the low point and a system of drainage pipes was installed to intercept excess water and carry it to a 16-ft. sump whence it is pumped into a discharge line.

An additional complication was provided by the intersection of the road and highway with an irrigation canal. This made it necessary to reconstruct the canal as an inverted siphon 17½ ft. below its normal grade.

President to Ask Bigger Canal

Considerable construction work is involved in defense program now before Congress

Immediate construction of a third set of locks for the Panama Canal will shortly be urged upon Congress by President Roosevelt, according to informed sources in Washington. The step will be urged as an essential part of the national defense program.

Enlargement of the capacity of the canal has been under study for a number of years and a report which, it is understood, will recommend this step is being completed by the Army Engineers. Adoption of this plan would automatically shelve proposals to dig a second canal, either in Nicaragua or Mexico.

It is believed that the President will also recommend the construction of a new highway across the Isthmus of

(*continued on p. 34*)

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Arkansas Avoids Clash With Federal Aid Rule

Arkansas attorney-general Holt ruled March 13 that the state's new contractor licensing law (*ENR* March 9, 1939 p. 7), does not apply to contractors bidding on work financed entirely or partly with federal highway aid funds. The ruling relieved fears that the new law might jeopardize the state's federal aid program.

After the bill had been passed, attention of state officials was drawn to the fact that the license requirement might be in conflict with a U. S. Bureau of Public Roads ruling of last November, that bidding on federal aid projects must be "free and unrestricted". Time before the adjournment of the state legislature was too short to permit repeal of the law. Governor Bailey announced before Holt made his decision that if the licensing act was held to apply to federal aid work, he would veto the still unsigned appropriation to finance work of the licensing board.

Construction Groups Meet In San Francisco

Conventions of contractors, roadbuilders, and manufacturers and distributors of equipment, together with Road Show, occupy construction week at Golden Gate

Construction Week at the Golden Gate International Exposition was marked by four simultaneous conventions of construction groups and a Road Show larger and more substantial than those usually held in the off years between biennial major roadbuilding shows. The American Roadbuilders' Association, the Associated General Contractors of America, the Western Association of State Highway Officials, the Highway Industries Association and the Associated Equipment Distributors held separate meetings during the week, with an attendance that included many men from Mid West and East in addition to the large number from states west of the Rockies. Activity was divided between the convention sessions, the Road Show, and the Golden Gate Exposition on Treasure Island.

The Road Show, occupying the three large exhibit spaces of the Civic Auditorium, presented tractors and trucks, some distributors and mixing and processing plants, in addition to smaller equipment and material, while shovels, scrapers and other heavy equipment were generally absent. Several operative model machines attracted attention.

In the convention sessions, improvement of labor relations was a leading theme of discussion by the Associated General Contractors. The roadbuilders gave attention to soil stabilization, road safety, highway finances, superhighways and many other subjects. The Western Association of State Highway Officials, which held its regular annual meeting in Reno recently, devoted the present meeting largely to local problems.

Individual summaries of the meetings appear below, while technical notes and abstracts of papers will be published in the March 30 issue.

Roadbuilders' Sessions

With the convention slogan "Highways of Tomorrow," the American Road Builders Association held its 36th annual meeting in the Civic Auditorium of San Francisco last week. More than 90 addresses, papers and committee reports were on the program.

In harmony with the slogan, the opening highlight of the convention was a call by President Murray D. Van Wagoner, state highway commissioner of Michigan, for early construction of a super-highway network to provide an efficient, safe and economical road transportation system. A similar plea was made by Charles M. Upham, engineer-director of the Association.

Extended attention was given to earth-road matters, which occupied several sessions whose full attendance reflected the close interest that all the states are giving to soil stabilization and better fill construction. Much interest was displayed also in road safety; papers on accident records, better study of road location and details to eliminate dangers, highway lighting as a safety aid, etc., gave evidence of the study that is being given to means for reducing traffic accidents. Data presented showed that, while accidents per unit of population are increasing, the number of accidents per vehicle-mile is decreasing.

Superhighways and tolls

President Van Wagoner opened his plea for superhighway construction by asserting that highway growth is lagging far behind motor vehicle growth, and by pointing out the need for limited-access roads to modernize highway service. Cost estimates made in Michigan indicate that such roads, on a basis of adequate design, would run to $300,000 per mi. in rural districts, and $1,600,000 per mi. in city areas. He proposed a federal revolving fund of $1,000,000,000 maintained for 25 years and repaid in part or in whole through tolls or through a 1-cent increase in the federal gasoline tax.

Right-of-way widths of 1,500 ft. should be acquired, for controlled resale of the directly benefited land. The speaker suggested that the federal government acquire tax-delinquent real estate, particularly in cities, for right-of-way and other federal purposes, such purchase to be handled through a Federal Land Authority.

Frank W. Clark, director of the California department of public works, in an address on California's construction policy on highways and other public works, spoke vigorously in favor of public ownership of utilities, including distribution of power from Shasta Dam and mentioned also that California's governor has recommended that the operation and maintenance of the Central Valley project be taken over by the state when the Bureau of Reclamation has completed construction. He said that he favored federal aid to all political subdivisions, and that "I for one am in favor of national spending so that public improvements can be carried on."

Other important addresses were made by Mayor A. J. Rossi, of San Francisco, Dr. L. I. Hewes, deputy chief engineer of the U. S. Bureau of Public Roads, Charles H. Purcell, state highway engineer of California, and Edward P. Palmer, president, A.G.C.

Mr. Palmer spoke of both public relations and labor relations as vital present-day problems of the construction industry. Illustrating bad public relations he cited the common highway warning sign "Road Closed—Travel at your own risk" as creating needless hostility between public and roadbuilder; he added that contractors often are even more at fault. In respect to labor relations, he said that this problem presents the most exacting part of the contractor's job today; "It calls for patience and a certain abiding faith in human nature. Our biggest problem is to find how men can learn to live and work with each other."

Earth road problems

Soil stabilization, leading present-day problem in the earth-road field, was discussed in a number of sessions, some of which were held jointly with the Western Association of State Highway Officials. Reports of field practice and films of field methods in building both soil bases and surfaces were presented by representatives of all of the principal stabilizing materials, including asphalt, tar, bituminous emulsions, calcium chloride, portland cement and lignin. Large-scale soil stabilization work on the runways of the San Francisco airport was described by A. J. Wehner, construction engineer at the airport, where material is mixed in place both by hand and by traveling mixer plant, and imported quarry-run material is treated in a stationary mixing plant. Theoretical and laboratory papers dealt with shear test data, use of the stabilometer, load transmission through pavements, and related subjects. Results of experiments on load distribution by stabilized-aggregate roadbeds 4 to 12 in. thick were reported by Prof. G. E. Hawthorn, of the University of Washington, showing increased gain in distribution as the thickness was increased.

Said at A.R.B.A. Convention

. . . I, for one, am in favor of continued national spending so that public improvements can be carried on. . . . *Frank W. Clark, director, California Department of Public Works.*

. . . Efficient America has too long paid too high a price for this nightmare of traffic congestion . . . *Murray D. Van Wagoner, president A.R.B.A.*

. . . At the present time labor relations is the most exacting part of the contractor's job. It calls for patience and a certain abiding faith in human nature . . . *E. P. Palmer, president A.G.C.*

. . . It is foolish to attempt to build a substandard bridge . . . *A. J. Meehan, senior bridge engineer, California highway department.*

. . . An act of God is most anything that a contractor runs into that makes him overrun his time limit . . . *R. M. Gillis, construction manager, California highway department.*

. . . Despite the 1938 reduction in highway accidents it is quite evident that night traffic is still abnormally hazardous . . . *A.R.B.A. Committee on Highway Illumination.*

. . . An appreciable subsidy is being paid by users of the state highway system to the users of roads not on the state highway system . . . *K. A. MacLachlan, California Department of Public Works.*

. . . Modern road mixing machinery has taken the guess out of emulsified asphalt stabilization . . . *A. J. Wehner, construction engineer, San Francisco Airport.*

Fill construction received much discussion. Leading contributions were by T. S. Stanton, O. J. Porter, R. M. Gillis, F. N. Hveem and other representatives of the California highway department, which has had 12 years of successful experience in building high fills without settlement by layer compaction at proper moisture content. Drainage of subgrades under fills threatened by sliding was also discussed.

Safe roads

Two sessions each were devoted to safe roads, to planning and to education. Safety problems received the most active discussion. Among the subjects dealt with were accident statistics and analyses, highway illumination, skidding, intersection design, ice control and guard rail construction. Committees reported progress on most of these subjects.

Road lighting was dealt with in a committee report on the subject and in a paper by William P. Bear, illuminating engineer, Pacific Gas and Electric Co., San Francisco, both of which strongly urged lighting to cut down night accidents.

Among other subjects of discussion were contract and specification clauses and their interpretation, by Floyd Booe, secretary-manager of the A.G.C. chapter at San Francisco, W. B. Brantley, chief engineer of the Georgia Highway Board, and Frederick Hoitt, secretary of the New England Roadbuilders Assn., Boston; ice control, by R. B. Traver, county superintendent of highways, Syracuse; bridges in relation to highway planning, by A. J. Meehan of the California highway department; a re-surfacing job at Sheboygan, Wis., by A. C. Droppers, county highway commissioner; and a report of experience with drainage and leaching on Treasure Island, by Charles H. Lee, San Francisco. Paul Rynning, engineer of Jackson County, Ore., reported that centralized county road administration reduced costs 30 per cent below those of a district system, although the county is 68 miles long and 48 miles wide.

Separate sessions were held by the highway contractors' division, the municipal officials' division, and the county officials' division, as well as by the California County Supervisors' Association.

Murray D. Van Wagoner was re-elected president and C. M. Upham was relected as engineer-director of the A.R.B.A.

Western Highway Meeting

Soil studies and safety were subjects of major prominence at the 18th annual meeting of the Western Association of State Highway Officials, held at San Francisco March 6 to 9 under the chairmanship of Charles D. Vail, Denver, and G. T. McCoy, Sacramento. In addition to three technical sessions of its own the association met in two joint sessions with the American Roadbuilders.

Discussions, conducted on the round-table plan, were devoted to safety, soil mechanics and time limits on contracts, with opinions and experience contributed in turn by each of the states represented. Particular interest centered on soil mechanics, a topic which came up repeatedly in successive sessions. Some western states have intensive soil studies actively under way, others have just started (Washington has built a new soils laboratory); all states represented gave evidence of deep interest in the general subject.

Officers elected for the coming year are Robert A. Allen, Nevada, president; B. G. Dwyer, New Mexico, vice-president; and E. C. Knowlton, Utah, secretary. The next place of meeting will be selected later by the executive committee.

A. G. C. Annual Convention

For the first time in its history the Associated General Contractors of America was addressed by a representative of organized labor at its 20th annual convention, held in San Francisco March 6–11. The address of John Possehl, president of the International Union of Operating Engineers and first vice-president of the AFL Building Trades and Construction Department, marked the start of a series of discussions on labor relations that dominated the convention. As A.G.C. president E. P. Palmer remarked, the association has made a complete about-face in its attitude toward labor in two short years, for at the San Antonio meeting in 1937 a motion to consider labor relations as an association activity was tabled under a storm of protest.

Competition of WPA was also a much-discussed topic, and the convention left no doubt as to the violent opposition of contractors to the invasion of WPA into construction of all types. A review of association activities over the past two decades, from the days of Garber, Cranford, Rogers, Bent and Winston down to the present, and a forecast of future activities received much attention. Legislation, both national and local, was thoroughly discussed. Nearly 800 contractors were in attendance.

Labor relations

Mr. Possehl pleaded for a better understanding between contractors and organized labor, as the welfare of both groups depends on the ability of contractors to get work and perform their operations at a profit. He declared that organized labor is opposed

NEW AND OLD OFFICERS OF THE A.G.C.

PAST, PRESENT AND FUTURE officers of the Associated General Contractors of America arriving at San Francisco for the start of the association's Twentieth Annual Convention. Left to right: Guy F. Atkinson, San Francisco, new president; H. B. (Pat) Zachry, Laredo, Tex., new vice-president; E. P. Palmer, New York City, retiring president; Edward J. Harding, managing director.

to WPA and is willing to help contractors in the fight against it.

Discussing the shortcomings of organized labor, Mr. Possehl stated that jurisdictional disputes are still with us, and no adequate machinery for handling them exists in the labor organization. The international unions recognize the problems of contractors working in more than one place, and are now ready to deal with contractors on a state-wide basis, thus eliminating the objections of employers having to deal with different locals.

In both the general sessions and the meetings of the highway, building and heavy construction divisions, the subject of labor relations was thoroughly discussed. In the past two years many contractors who formerly worked open-shop have gone union wholly or in part, especially in highway and heavy construction operations. Not one complaint was registered by such contractors against union labor; the opposition to unionization came solely from those contractors who have not tried it. The Washington staff reported helping and advising many local chapters, groups and individuals requesting help in labor matters. Under mandate of the membership, the national staff and officers cannot directly participate in labor negotiations except when requested, and even then their actions are not binding upon members who do not wish to be involved. A resolution passed by the convention reiterated this policy, barring any possibility of blanket binding of members.

The A.G.C. has long opposed day-labor operations, especially WPA, but never before with the bitterness displayed at this convention. A strongly-worded resolution demanded the abolition of WPA and substitution of PWA as the relief-work agency of the government, and further demanded that relief-labor construction be done by the contract system. Members from various states reported how WPA was taking over most of the public-works construction in their territories, buying equipment to enter construction directly in competition with contractors, and even reported cases of "high-pressure" selling of projects to local authorities by WPA engineers. Opposition was expressed both by resolution and reports to the Byrnes bill proposal to merge all relief and public works construction activities of the federal government in one department.

In two states, Texas and New Jersey, contractors have worked out with public officials a plan of WPA-contract work, whereby the WPA furnishes all labor and up to $6 per man month of materials, while the contractor provides the supervision, equipment, operators and remaining materials, bidding the work the same as for usual conditions, and working under the direction of the awarding authorities. Delegates from both states reported the plan to work satisfactory as a temporary expedient.

In contrast to the denunciation of WPA and day-labor operations, the convention by resolution commended the public works department of the Procurement Division, the Corps of Engineers, the Bureau of Reclamation, Bureau of Public Roads, Bureau of Yards and Docks and the Veterans Administration as regular federal departments using the contract system of construction. Secretary Ickes, head of the PWA, was also commended.

Future prospects

In his annual report Managing Director Edward J. Harding reviewed the past two decades of A.G.C. activity, especially the fight to preserve and consolidate the association in a period of declining construction markets, general business depression and competition from relief organizations. The A.G.C. has weathered the storm, he declared, and is now in a stronger position than it has been for years. Legislative activity will be a major item in the A.G.C. program.

Several speakers outlined the future of contract construction, but a paper by Lynn Atkinson, Los Angeles, created most interest. Atkinson advocated the building of elevated or depressed super-

A.G.C. Convention Briefs

. . . Construction must be allowed to use its ingenuity if it is to render that service for which it exists . . . *E. J. Harding, managing director A.G.C.*

. . . Contractors and labor have never been close enough to understand each other. We work together yet we fight together . . . *John Possehl, Int. Union of Operating Engineers.*

. . . This A.G.C. convention would perform a patriotic service by emphatically requesting that the government, presumably the Federal Committee on Apprentice Training, get the facts as to the available supply of trained mechanics in relation to our war needs . . . *W. J. Barney, chairman apprentice committee A.G.C.*

. . . Why should we not have as good city highway systems as we have county and state highway systems? . . . *Lynn Atkinson, contractor, Los Angeles.*

. . . We need to recognize the relief problem. Why can't contractors help develop a program to use relief labor? . . . *H. W. Morrison, contractor, Boise.*

highways through congested metropolitan areas as a major market for future construction and the best means of relieving the hazardous congestion of city traffic. He declared that city highway traffic has been neglected, that we run 1939 cars over 1919 streets, and that the American public demands relief from its antiquated street traffic facilities. His program for elevated highways was endorsed by the convention in a resolution, as was the construction of superhighways between cities.

Diversion condemned

To maintain highway construction, the convention passed a resolution condemning diversion of gasoline taxes and called for a federal aid program for each state equal to the gas tax and other highway revenue of the individual states.

H. E. Foreman, assistant managing director, urged A.G.C. members to fight the so-called merit rating plan for unemployment insurance premium payments, stating that it is entirely unfair to construction with its seasonal and intermittent employment.

W. J. Barney, chairman of the apprenticeship committee, forecast a disastrous shortage of skilled workmen in construction when the volume nears normal level. A survey of ten crafts by his committee indicated the need of 270,000 replacements annually to maintain proper strength in these skilled trades, while actual replacement is only 42,000.

New officers

Guy F. Atkinson, president of the Guy F. Atkinson Co., San Francisco, was elected president of the association for 1939. H. B. (Pat) Zachry, Laredo, Texas, was chosen vice-president. Under the new plan of having a representative of each of the three divisions in the twelve geographical districts on the board of directors, 36 new directors were elected.

• • •

Land Purchase Delays Grand River Project

Construction on the $20,000,000 Grand River project in Oklahoma is being delayed by difficulties which the Grand River Authority is experiencing in securing the necessary land and right-of-way. The authority's offers for outright purchase are being generally refused by land owners, and condemnation proceedings so far instituted have resulted in awards in many cases greater than the price asked by the land owner. It now appears that the total land cost of the project will considerably exceed the original estimate.

The Grand River Authority is building a 152-ft. high multiple arch dam at Pensacola (*ENR* Feb. 16, 1939 p. 222). The 51 arch sections, each spanning 24 ft., will be flanked by an 860-ft. long gravity ogee spillway and a 450-ft. concrete gravity non-overflow section. A power house built in the river channel below the dam will generate 64,000 kw.

Bureau of Reclamation photo

SHASTA SHOOFLY TUNNEL HOLED THROUGH

Workmen broke through the last barrier in the railroad relocation tunnel around the site of Shasta Dam early this month, and the opening has now been brought to its full 28-ft. height and 26-ft. width. The tunnel is being lined for its entire length with 18 to 21 in. of concrete.

Shasta Dam on the Sacramento River in California, part of the Central Valley project, will block the main-line track of the Southern Pacific Ry. In order to permit construction to proceed on the dam while a permanent relocated line is being built for Southern Pacific, the Shoofly Tunnel is being driven under the abutments of the dam. It will be used by the railway for about two years until the permanent new line is completed and later will be used to divert the flow of the river.

Highway Industries Group Re-elects Parrish

At its meeting during the construction week at San Francisco, the Highway Industries Association re-elected William M. Parrish, International Harvester Co., Chicago, as president, H. N. Schramm as vice-president, and George F. Schlesinger as secretary and treasurer.

LABOR NOTES

Construction of the new $2,000,000 Pennsylvania Avenue Bridge over the Anacostia River at Washington, D. C., has been almost completely halted by a dispute between A.F.L. unions of pile drivers and reinforcing rod workers as to which union should be assigned the work of cutting off the ends of reinforcing rods used in concrete piles. The Penker Construction Co. is contractor on the job for the District of Columbia.

The North Carolina state highway and public works commission is having trouble finding a sufficient number of qualified draftsmen and engineers. The higher salaries paid by private firms and by various federal agencies have caused a number of men to leave the state service recently according to W. Vance Baise, chief engineer of the commission.

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Detached Auto Trailer Is Legally a Building

An automobile trailer is legally a building when it is detached from an automobile, the federal district court at San Antonio held Mar. 7. The case arose out of an attempt to collect on an insurance policy for a death caused by the burning of a trailer; the policy specified that payment would be made only for death caused by the burning of a building. The court held that the insurance company must pay.

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Alabama and Rhode Island Adopt Civil Service

Passage of civil service acts this month by the legislatures of Alabama and Rhode Island brought 8,000 state employees under the merit system. The Alabama law covers all state departments and includes a position-classification plan, a salary and wage schedule, systematized promotion and transfer, and in-service training of employees. The Rhode Island act is unusual in providing for open competitive examinations for the state personnel director.

Adoption of civil service by these two states brings to fifteen the number of states operating under a merit system law. At present, civil service measures for state or local government are pending in seventeen state legislatures, while in Minnesota and North Dakota state civil service acts have already passed one house of the legislature and is pending in the other house.

WASHINGTON HIGHLIGHTS

Special reports by Paul Wooton

CIVILIANS who worked on construction of the Panama Canal are declared eligible, upon retirement, to receive annuities based upon their rate of pay and length of service under the terms of a bill which passed the Senate Mar. 8 and which has still to be acted upon by the House. Service on the Isthmus for three or more years between 1904 and 1914 is required in order to receive benefits under the bill.

HEARINGS have started on the annual non-military appropriation bill for the War Department before a subcommittee of the House appropriations committee. It is understood that the Army requested $195,000,000 for expenditure on river and harbor improvements and flood control during the fiscal year ending June 30, 1940, but that the figure was reduced by the Budget Bureau to $110,000,000. A group of some 50 Congressmen has organized informally for the purpose of restoring the appropriation to the full amount requested.

PERMANENT establishment of the National Resources Committee, already proposed by Senator Hayden (*ENR*, Mar. 9, 1939, p. 3), is also called for in a bill introduced by Senator Wagner. Wagner's measure would re-establish the Federal Employment Stabilization Board which was set up in 1931 and abolished in 1934. The board, which would take over the functions, records and personnel of the present National Resources Committee, would be charged with drawing up a continually revised program of federal public works extending six years into the future. It would act in an advisory capacity only and would report to the President.

THE REQUEST for an appropriation of $5,000,000 to finance construction of water conservation projects in dry areas which the President made last year has been renewed in a letter to Speaker Bankhead of the House. The money would be allocated to such departments of the federal government as the President might designate and would be supplemented by WPA labor.

NEARLY 10 per cent of federal government employees under civil service in the month of January, 1939, were engaged in construction work of various kinds, including buildings, naval vessels, highways, and other activities, according to a report by the Civil Service Commission. A total of 863,911 persons were on the civil service rolls, of whom 83,317 were classed as construction personnel.

LARGEST volume in a decade of small residential construction is expected on the strength of steady gains in the volume of applications for mortgage insurance by the Federal Housing Administration. During the week ending March 4 such applications marked a new all-time high of $26,263,496, or nearly $5,000,000 per day, as compared with $21,425,892 for the preceding week and $17,613,402 for the corresponding week of 1938. Over 70 per cent of this volume represents new construction. Since the first of the year mortgage applications have totalled $163,807,405, as compared with $72,516,837 during the same part of 1938.

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Bacterial Reduction Tried in Dump

The city of Chicago has begun experiments with a patented process for the use of thermophilic bacteria to prevent nuisances arising from the city dump. The bacteria, incorporated in a mixture of gypsum, limestone dust, peat, molasses, and wood ashes, are mixed with each load of garbage before it is dumped and at the end of each day are spread over the top of the day's dumping.

The bacteria begin at once to consume the garbage and to multiply. Their action generates a heat of 160 to 170 deg. which destroys vermin in the garbage while at the same time the reduction of the garbage by the bacteria prevents odors.

The city is trying the process at two of its dumps under a $6,000 appropriation voted recently by the city council. If the experiment is successful, it is expected that the process will be used at other city dumps.

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High Point Hydro Project Is Licensed

The Federal Power Commission has granted a 50-year license to the City of High Point, N. C., to build a 30,000-hp. hydro-electric development on the Yadkin River near Styers Ferry. The city is required to begin construction by June 1 and to complete the project in three years.

The commission found that the project will affect commerce on the Yadkin River and therefore that a license was required.

The High Point project will consist of a dam about 80 ft. high and 2,520 ft. long, providing usuable storage of about 231,000 acre-ft.

Arizona Ratifies Compact Subject to Condition

By act of its legislature Arizona on March 3 conditionally ratified the Colorado River or Santa Fe compact for apportionment of water of the Colorado River between the upper basin and lower basin states. The condition is that a tri-state agreement be concluded between California, Nevada and Arizona for apportionment of the lower basin's share of the river's flow.

The Colorado River Compact, drawn up in 1922 at Santa Fe by a conference of representatives of the seven states of the basin, with Herbert Hoover participating for the federal government, was subsequently ratified by all of the states except Arizona. It allots 7,500,000 acre-ft. of water per year to Wyoming, Colorado, Utah and New Mexico, the states above Lee Ferry, and 8,500,000 acre-ft. to the three states below Lee Ferry, Nevada, California and Arizona, with provision for future apportionment of any surplus water. In the Boulder Canyon act Congress subsequently made all the rights in water stored by Boulder Dam subject to the compact.

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Plans Are Announced For Niagara Bridge

Details have been announced for the bridge which the Niagara Falls Bridge Commission proposes to build over the Niagara River at Niagara Falls, N. Y., to replace the Falls View Bridge which was carried out by ice a year ago. Designed by Waddell & Hardesty of New York City and Edward P. Lupfer Engineering Co. of Buffalo, the proposed bridge will be about 1,450 ft. long, with a main span consisting of a 960-ft. steel arch. The 58-ft. wide bridge will carry four lanes of traffic plus a 10-ft. promenade on the side of the bridge facing the Falls and a catwalk along the center, elevated 4 ft. above the bridge deck.

The hinges of the arch will be 55 ft. above low water, or about 29 ft. higher than those of the old Falls View Bridge.

Plans for the new bridge call for a location 350 ft. north of the old structure and for construction of broad plazas at each end.

The right of the commission to construct the bridge is still being contested by the International Railway Co., owner of the wrecked bridge. The railway company contends that its franchise is still good and has announced its intention of replacing the Falls View Bridge. Both the commission and the railway company have already let contracts for borings.

Sewage Works Men Meet in New Jersey

Interstate pollution compacts discussed and chemical coagulation progress outlined

State compacts for the control and abatement of pollution are winning acceptance as the most effective means of coping with the problem of interstate waterway improvement, said Seth G. Hess, chief engineer of the Interstate Sanitation Commission, at a meeting of the New Jersey Sewage Works Association on March 9-10. The speaker pointed out that following the formation of the Interstate Sanitation Commission in 1936, to deal with New York Harbor and adjacent waters, has come the Delaware Basin Commission, and more recently a commission to control pollution in the Ohio River Basin. (*ENR*, Mar. 9, 1939, p. 858).

Among the technical papers at the two-day meeting of the association was one by Willem Rudolfs, chief, division of water and sewage research, New Jersey Experiment Station, outlining research findings concerning activated sludge treatment, stream pollution, growth-promoting substances in sludge and recent developments in chemical coagulation. In connection with the latter, he pointed out that pre-sedimentation is generally neither detrimental nor helpful to clarification, except where lime and iron salts are used together; lime and ferric chloride can be added in either order, but addition of lime first is recommended. For the most economical use of the chemicals, very rapid mixing of coagulant and sewage is necessary. Air used for stirring and mixing during coagulation produces desired results more quickly, but appears inferior to mechanical flocculators from the standpoint of clarification. It was also stated that the return sludge has some, though not extensive, clarifying value.

Officers elected for the coming year were: Edward Molitor, president; S. R. Probasco and H. Van Der Vleit, vice-president; Paul Molitor, Jr., treasurer; and John R. Downes, secretary. The meeting, held in Trenton in cooperation with the New Jersey State Department of Health, was attended by about 250 members of the association.

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Phillips Heads Equipment Distributors

Associated Equipment Distributors, at its meeting on March 6 at San Francisco, elected V. L. Phillips, of Kansas City, as president; Robert Nixon, of Chattanooga and William Morgan of St. Louis, as vice-presidents; and A. C. Blaisdell, of Cincinnati, as secretary-treasurer.

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Former Highway Head Indicted in Minnesota

N. W. Elsberg, former state highway commissioner of Minnesota, as well as Loren L. Allen, former maintenance engineer, J. T. Flannagan, former assistant maintenance engineer, and the S. J. Reader Co., Minneapolis contractors, were indicted March 9 on charges of willful neglect of official duties. The indictments, brought by a Ramsey County grand jury at St. Paul, also charged false auditing and payment of claims and wrongful receipt of state funds.

Elsberg, Allen and Flannagan were officials of the highway department until they were removed last January by the new Republican administration.

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PWA Jobs Moving On Schedule

About 560 PWA-financed projects, federal and non-federal, have already been completed, representing a construction cost of nearly $20,000,000, the Public Works Administration announced March 13. Of the 5,600 non-federal projects under construction at a total cost of $1,400,000,000, more than 500 have been completed at a cost of about $15,700,000. About 60 of the 1,829 federal PWA projects are finished, representing $3,568,000 of the $196,431,000 federal PWA program.

Bulk of the completed federal projects have been sponsored by the Bureau of Reclamation, which put many of its projects under construction late last June, immediately after the passage of the 1938 PWA act.

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Cross Named Consultant On Hospital Settlement

Hardy Cross, professor of structural engineering at Yale University, has been selected by the board of directors of New Orleans Charity Hospital as the second consultant to study the reported settlement of the recently completed hospital building. Last week the board appointed Karl Terzaghi, authority on soil mechanics.

Appointment of both men has been approved by the Public Works Administration, which suggested that such a study be made after reports reached it that the building had settled as much as 9 inches.

OBITUARY

Thomas A. Panter, who has been serving as chief engineer for the joint Congressional committee investigating the Tennessee Valley Authority, died in Los Angeles, March 12. Panter had recently returned to California from Washington, after submitting his report to the committee.

Jean C. Tache, for 40 years an engineer with the Canadian Department of Public Works, died on March 8 at Rimouski, Quebec, at the age of 86. Tache retired some years ago, but since his retirement he had worked in Montreal, The Yukon, Chicoutmi, and Rimouski.

Donald W. Ross, Montreal Construction Engineer, died there March 3, aged 66. Ross was a graduate of Massachusetts Institute of Technology and in his earlier years had worked with the Baldwin Locomotive Works at Philadelphia and the Dominion Bridge Co. at Montreal. He was active in contracting work in Canada for many years as a member of the firm of Church, Ross & Company.

E. P. J. Courval, chief draftsman in the technical service of the City of Montreal died March 7. Courval had been with the city since 1910 and had been chief draftsman since 1919.

James C. Barker, Memphis contractor, died there March 2 at the age of 57.

E. J. Lee Rust, 61, president of the Rust Engineering Co. of Birmingham, New York and Pittsburgh, died in Birmingham, March 2.

John P. Northey, a hydraulic engineer active in Toronto before the turn of the century, died in Hamilton, Ont., March 6, at the age of 81. Northey began his career as a hydraulic engineer in 1878 and sold his business to the Canadian General Electric Co. in 1904. Since that time he has devoted himself to the invention and manufacture of a fog signaling device.

Frank A. Merril, president of the Merril Co. of South Boston, Mass., died in Malden, Mass., March 10.

Jeremiah J. Murphy, for 25 years assistant manager of the Buffalo Division of the Great Lakes Dredge and Dock Co. died in Buffalo, March 5, aged 66.

Robert E. Orr, New York City general contractor, died in Yonkers, N. Y., March 10, at the age of 51. Orr, a native of Ireland, graduated from Cooper Union in New York City, in 1918. He served with the 15th New York Engineers during the war and after the war became a partner in the contracting firm of Mathieson & Orr. In 1930 he organized the Robert E. Orr Co.

Frank J. Smith, 58, who was superintendent of construction at Grand Coulee Dam for Mason-Walsh-Atkinson-Kier under the first contract, died at Pendleton, Oregon, Feb. 26. Smith was credited with developing the belt conveyor system which handled over-burden from the dam. He was superintendent of construction on the East Boston Vehicle Tunnel. At the time of his death he had been making preliminary surveys for some gold dredging operations.

Patrick J. Deeny, an engineer in the Seattle city engineer's office since 1906, died in Seattle, March 2, at the age of 65.

John H. Asher, who had held the post of county surveyor of Madison County, Ohio, for 25 years when he retired twelve years ago, died in London, Ont., March 3, at the age of 86.

Jesse F. Jones, Memphis levee contractor, who has been a partner since 1918 in the firm of Jones & Rodgers, died in Memphis, March 3, at the age of 56.

Clarence M. Field, president of the Minneapolis civil engineering firm of Egan, Field & Nowak, died Feb. 27, at the age of 58.

Rod McColl, former chief engineer of Nova Scotia and a graduate of the Royal Military College, was killed March 2 in a hotel fire at Halifax.

Robert R. Murray, formerly on the engineering staff of the Nova Scotia highway department, and recently engineer for the equipment firm of William Stairs Son & Morrow, was also killed in the fire at Halifax. Murray was for some years on the faculty of Nova Scotia Technical College.

Clarence S. Coe, first city manager of Miami, Fla., and lately a member of the Miami Housing Authority, died recently at Bay Pines, Fla., aged 74. Coe, a graduate in 1889 of the University of Minnesota, worked about fifteen years on various middle-western railways and in 1905 joined the staff of the Florida East Coast Ry. As division engineer, he was in charge of the Key West extension of the line. During the war he served overseas as commanding officer in the 17th Engineers, with the rank of Colonel, and later was advisor to the Serbian government. It was after this assignment that he became city manager at Miami.

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President to Ask Panama Canal Changes

(Continued from page 27)

Panama, to be located outside of the Canal Zone.

Other items of construction interest in the defense plan, which is embodied in half a dozen pending measures, include the authorization of $23,750,000 for the construction and rehabilitation of buildings and utilities in connection with seacoast and antiaircraft defenses of the Canal Zone, already approved by both Houses, and authorization of twelve new naval bases for surface vessels and aircraft, which has been passed by the House and is now receiving Senate consideration. This is the bill which contains the controversial provision for the improvement of the harbor at Guam.

In addition, a bill to authorize approximately $50,000,000 in navy yards and other shore establishments is in preparation, and a number of minor measures have been introduced.

CONTRACTS AND CAPITAL

Engineering construction awards for the week, $46,449,000, are 27 per cent above a week ago, but 9 per cent below the volume for the corresponding 1938 week.

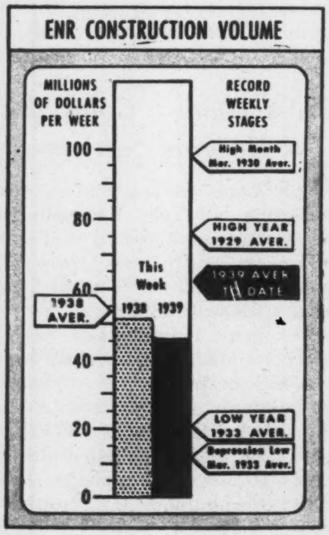
Cumulative awards for 1939 to date total $684,165,000, 20 per cent above the $568,427,000 reported for the initial 11-week period in 1938.

Private construction for the current week is 90 per cent higher than a week ago, but 3 per cent below a year ago. Public awards are 6 per cent above last week, but 12 per cent below last year.

In the classified construction groups, waterworks, bridges, industrial buildings, commercial building and large-scale housing, earthwork and drainage, streets and roads, and unclassified construction are above their respective volumes for last week; and waterworks, sewerage, bridges, streets and roads, and unclassified construction top their 1938-week totals.

New capital for construction purposes for the week, $8,344,000, is 93 per cent lower than the total for the corresponding 1938 week. The current week's total includes $8,044,000 in state and municipal bonds, and $300,000 in corporate security issues.

New construction financing for the year to date, $478,809,000, is 42 per cent higher than the volume reported for the 11-week period last year.



CONTRACTS

(Thousands of dollars)

	Week Ending Mar. 17 1938	Week Ending Mar. 9 1939	Week Ending Mar. 16 1939
Federal	$5,904	$3,748	$2,000
State & Municipal	26,810	23,582	26,942
Total public...	$32,714	$27,330	$28,942
Total private..	18,070	9,245	17,507
TOTALS	$50,784	$36,575	$46,449

Cumulative
1939 ......(11 weeks).....$684,165
1938 ......(11 weeks).....$568,427

Note: Minimum size projects included are: Waterworks and waterways projects, $15,000; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1938 11 Wk.	Cumulative 1939 11 Wk.
NON-FEDERAL	$337,605	$205,309
Corporate securities	90,364	32,137
State & Mun. bonds	187,368	132,022
R.E.A. loans	.....	15,631
R.F.C. loans.......	62,370	45
P.W.A. allotments..	— 2,497	.....
U.S.H.A. loans	.....	25,474
FEDERAL	.....	275,500
TOTAL CAPITAL.	$337,605	$478,809

FHA MORTGAGES

	Week Ending Mar. 12 1938	Week Ending Mar. 4 1939	Week Ending Mar. 11 1939
Selected for appraisal ...	$20,387	$26,263	$25,700*

Cumulative
1939 ......(10 weeks)....$203,491*
1938 ......(11 weeks)....$111,794

* Subject to revision.

ENR INDEX NUMBERS

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Construction Cost	Mar.	234.43	112.69
Building Cost	Mar.	196.46	106.20
Volume	Feb.	187	82

COMMENT AND DISCUSSION

Readers' opinions on matters that concern the engineer

Landfill Refuse Disposal

Sir: Announcement of the landfill reasearch at New York University (*ENR* Mar. 2, p. 74) is encouraging to those concerned with municipal sanitation and economics. It is a worthy outgrowth of the article by E. J. Cleary on landfill refuse disposal in New York City. (*ENR* Sept. 1, 1938, p. 270.) The article and the many letters pro and con (mostly pro) that were published in your columns during the year were a notable contribution to the literature of what the British call "municipal cleansing." As long ago as 1913–15, Seattle, Wash., adopted the "sanitary-fill" method of garbage and refuse disposal. Among other places that followed suit were Ottawa, Ont., in 1918, Dundee, Scotland, in 1928; and San Francisco (mentioned by Mr. Cleary) some five years ago. At Seattle, three comparatively new incinerating plants, built by the engineering department, were abandoned by the health department when it took over refuse disposal. This was remarkable in view of the predilection of health departments generally for incineration. More notable still was the later action of the British Ministry of Health in sanctioning "controlled tipping" or refuse disposal on land.

Far be it from me to decry incinerators, especially now that their design and operation is more and more generally put into the hands of competent engineers. But that it is not the only sanitary means of refuse disposal and may in some instances be the most costly appears to be shown by Mr. Cleary's exposition of current practice in New York City.

A factor that should always appear in comparative estimates of the cost of refuse disposal by various methods is the length of haul to the sanitary fill, the incinerator, the hog farm or the reduction plant. Theoretically, incinerators may be located in the center of refuse-collection districts, thus giving a short haul. Practically, this is not always feasible owing to more or less sentimental objections of property owners to the location of an incinerating plant nearby and to the more substantial objection to the procession of garbage trucks to the incinerator. For these and other reasons incinerators are generally located in outlying districts. In many cities sites for sanitary fills would require no longer hauls than for incinerators.

It should be remembered that the capital outlay for incineration adds materially to a city's bonded debt and that annual capital and operating charges are high. Net revenue from heat utilization is uncertain. With sanitary fills waste land may be reclaimed with little capital outlay. On marsh lands nuisances may be averted, including, in some cases, mosquito breeding.

M. N. Baker
Upper Montclair, N. J.

Still on the Job

Sir: May I call your attention to an error which I just noticed on p. 5 of your issue of Feb. 9. Under the heading, "Pennsylvania Opposes Flood Control Program," the statement appears, "Among those whose jobs were terminated . . . were . . . Frederick H. Weed . . ."

I should like to correct that statement. My job of division engineer in connection with the flood control work in western Pennsylvania has not been terminated. The statements as they appeared in the press in reference to my name were in error.

Frederick H. Weed
Division Engineer
Pittsburgh, Pa. Feb. 20. 1939

Questionable Practice

Sir: I wish to call your attention to an article which appeared in *Engineering News-Record*, Jan. 5, p. 30, describing the use of an aluminum pressure cooker to generate carbon dioxide from "Dry-Ice." It was reported that engineers of the Tennessee Valley Authority used this gas pressure for spraying paint.

As manufacturers and sellers of "Dry-Ice" we condemn the publicity given such an application because of the danger involved. In the hands of a competent engineer this hazard may be minimized, but there is no telling what may happen if cookers or other containers are used promiscuously for generating CO_2 under pressure from "Dry-Ice." As you probably know, pressures as high as 850 lb. per sq.in. may easily be obtained from the sublimation of "Dry-Ice" in a confined space at ordinary temperatures.

If it is at all possible, we would appreciate your advising your readers of the danger involved in this practice and to discourage its use as much as possible. After all, an approved I.C.C. cylinder of carbon dioxide can be bought at comparatively small cost as against using a make-shift pressure container which may cause trouble.

A. J. Granata
Mgr. Applied Engineering
Pure Carbonic, Inc.
New York, N. Y., Feb. 28, 1939

Sewage Disposal Progress

Sir: With reference to your recent inventory of sewage disposal facilities (*ENR*, Jan. 19, 1939, p. 60), I would like to point out that while there has not been any very considerable progress in the installation of treatment works in Massachusetts during the year 1938, plans have been recently approved by the Department of Public Health for sewage treatment works in 13 cities and towns to serve a total population of nearly 300,000.

Also an investigation is under way at the present time with a view to treating the sewage now discharged into Boston harbor from 32 municipalities with a total aggregate population (1935 census) of 1,850,652. I feel also that your readers should be acquainted with the fact that sewage from a very considerable percentage of our population is disposed of in tidal waters where there is no nuisance or danger to the public health so far as careful investigation by sanitary engineers could show.

Also I feel that a statement is due relative to our neighboring state of Vermont where there is practically no sewage pollution to any stream. I think you will find similar conditions in a large proportion of New Hampshire and Maine.

Arthur D. Weston
Chief Engineer,
Department of Public Health
Boston, Mass.

ENGINEERING NEWS-RECORD

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MARCH 16, 1939

LAST WEEK'S ASSEMBLY of construction groups at San Francisco was the first comprehensive foregathering of construction interests in six years, and it surpassed even the meeting at Detroit in 1933. Characteristically, it included no direct cooperation, yet the occasion brought men of different pursuits into contact, where they could become acquainted, and this contact may lead to developing closer sympathies. It is to be hoped that gatherings like that at San Francisco will take place again, and that construction men may acquire the habit of meeting together and learning to value each other's opinions on the urgent problems of the construction field.

A Lesson in Lighting

IN LIGHTING 200 miles of main road the state of New Jersey has accomplished a task that has a significance beyond this remarkable record of mileage. As is emphasized in the account on a following page, the road-lighting activities were a cooperative work. In most cases, local participation was involved in state action; towns and counties went deep into scanty purses to contribute money as well as moral support to the state's campaign for safety to night travel. This called for promotional work of the highest quality by the state highway department officials. It is important to note that the methods are simple; no vast promotional organization had to be built up; man-to-man conference and plain fair dealing brought a meeting of minds. Equal resources are open to any highway department that approaches its task with conviction of the value of highway lighting.

Originality in Sewage Disposal

ONE of the special problems of providing utility service occurs in the design of facilities that can cope with peak loads and yet be economically adapted to handling the average load. The problem probably reaches its greatest complexity at summer resorts where peak population loads reach fantastic proportions. At Virginia Beach, for example, where a sewage disposal treatment plant has just been built, the year-round population varies from 2,500 to 40,000. Here the designers were faced with an unusually difficult assignment—to provide treatment works which would function at top efficiency when the greatest flow load occurred, and yet could be operated with economy during the winter period when the flow was at a minimum. How these unusual conditions were met in a plant designed with special features of flexibility is described on page 385. The Virginia Beach plant, like the one recently built at Greensboro, N. C. (*ENR* Sept. 15, 1938, p. 321) where textile wastes are treated, illustrates original thinking in the design of sewage disposal works to meet special conditions.

Not Yet Settled

RATIFICATION of the Colorado River compact of 1922 by the state of Arizona, nominally accomplished by legislative enactment two weeks ago, is coupled with a stipulation or condition that makes the ratification of questionable meaning. The condition is that California, Nevada and Arizona agree on their respective water rights in the river. Past attempts to frame such an agreement make it doubtful whether the condition can be fulfilled. Even if it is fulfilled there may be legal question whether the result will constitute a valid ratification. The fairest statement under the circumstances is that the long-pending controversy over Colorado River water is not yet settled. This is unfortunate even though no present issues depend on Arizona's ratification. The development of comprehensive water plans for the Colorado River basin remains under a cloud of uncertainty so long as complete agreement of the states concerned has not been attained. Ratification of the compact without reservation would provide such agreement and would not appear to jeopardize Arizona's rights.

For Continuous Structures

UNTIL Professor Hardy Cross introduced his method of moment distribution for rigid frame analysis in his classic paper of nine years ago, indeterminate structures were rarely used in this country. Despite their recognized advantages they required more design labor than they were worth. Professor Cross, in effect, substituted arithmetic for calculus and made the continuous beam an article of commerce. Indeterminate structures are now used more often than they are avoided. As a consequence, refinements in design procedure are at a premium and numerous designers have developed variations of the Cross method that fit their particular needs or fancies to better advantage. In this issue we present one of these variations that goes farther than most in introducing a fundamental improvement. Like the Cross method, it is based upon a series of successive approximations but instead of balancing moments about a joint, section moduli, which are moments divided by a constant, namely working stress, are balanced. And since section modulus, or the necessary size of the beam, is the objective of the analysis, the method is quite direct. The usefulness of the article, however, rests not so much in its introduction of a new method as it does on the procedural application that Dean Grinter, the author, has worked out. By it a minimum of calculation is required and, most important, the calculation gives the designer a continuous picture of the physical changes to which he is subjecting his proposed structure. Thus the method would seem to offer an opportunity to remove both some of the drudgery and some of the darkness from continuous beam design.

The First Step

JUST TWO YEARS AGO a motion made at the San Antonio convention of the Associated General Contractors of America to consider labor relations as an association activity was tabled in a storm of protest. Last week at San Francisco the association heard an international union president speak from the convention floor. These two incidents define the progress made by contractors in labor relations during the past two years.

In these two years the contractors have seen unionization spread to heavy construction and highway work and to building activities outside of metropolitan areas. Many contractors have abandoned life-long open-shop practices. Significant is the fact that not a complaint against union-labor operations was voiced at last week's convention by contractors who had tried the system.

The A.G.C. is handling labor relations on a sound basis, proceeding cautiously, trying to learn and to understand, and binding no member in any agreement who does not wish to be involved. On the other side, organized labor is showing tendencies to meet construction employers on a basis of mutual understanding.

Labor problems in construction are far from solved, but the desire for mutual understanding by both constructors and labor leaders marks the first step toward better and more satisfactory labor relations in the construction industry.

Keep the Door Open

A BILL is now before the New York State legislature to amend the engineer license law by adding to the qualifications for license a two-year pre-engineering college course. Thus, the mandatory college training to obtain an engineers' license is to be increased to six years, the license board being granted discretionary power to waive the college training requirement in the case of men who can demonstrate to the board that they are otherwise qualified to be licensed. To keep the added two years from increasing the total training period, the revisions permit them to be counted as two years of practical experience and the years of practical experience have been cut to two.

Most engineers recognize the difficulty of trying to give boys a sound training in the fundamentals of engineering in a four-year period without neglecting education in those liberal arts that help to give the student a broad approach to life's problems, and many have advocated two years of general cultural training or even an academic degree as a preliminary to taking up the study of engineering. But such extensive training is something that can only be viewed as an ideal for a young man willing and able to devote that much time and money to scholastic pursuits; it is not a necessary requirement to give a man ability to design safe structures, which is the sole objective of a license law.

But there is another angle to this proposed change in New York's license law. The six-year period of college training is made mandatory except in cases in which the license board in its discretion waives that requirement. This makes it possible for the license board to exclude from licensed engineering practice *all men* who are not able to take a six-year college course. Set that fact over against the present strong movement to limit the number of young men who seek to become engineers, and the seriousness of what is now proposed as it affects the young man of limited means becomes evident. Under the guise of protecting the public against unsafe construction the profession should not ask the state to put in the hands of any board the power to close the doors of engineering to the young men who aspire to gain fame and fortune in its service. The measure of a man's ability to design safe structures should not be *how* or *where* he obtained his training but what he *knows* when he comes to the license board for examination.

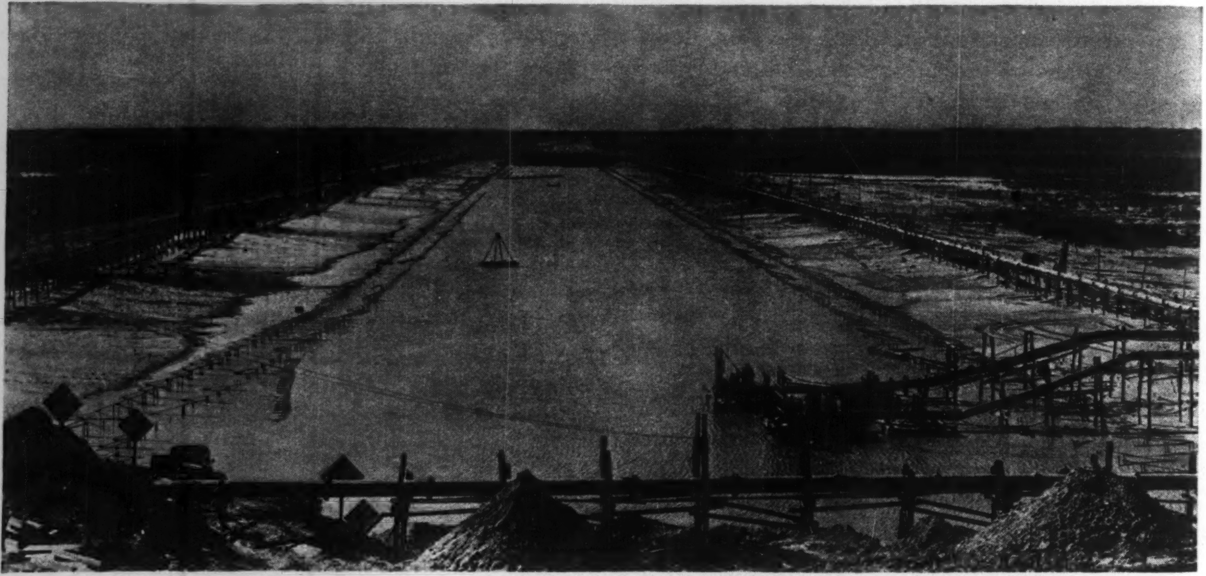


FIG. I. THE DREDGE DISCHARGE LINES AT SARDIS DAM FORM A COMPLETE LOOP AROUND THE CORE POOLS.

First Mississippi Flood-Control Dam

Contents in Brief*—Sardis Dam on a tributary of the Yazoo River in Mississippi adds the first headwaters detention reservoir to the modern flood-control works of the lower Mississippi River. Nearly 13,850,000 cu.yd. of hydraulic fill in a 2¾-mile earth embankment of 16,760,000 cu.yd. forms a flood detention reservoir of 1,500,000 acre-ft. capacity. As the first of several flood-control dams listed in the revised lower-Mississippi flood-control plan and as a trial of delta soils for hydraulic fill the work has great experimental interest.

SARDIS DAM is the first in a new order of structures for flood control on the lower Mississippi River. Incidentally, next to Fort Peck and Kingsley (Keystone) dams it is the largest hydraulic-fill dam in the United States. But size is not of prime interest compared with the purpose of the work. This is unique in the long history of Mississippi River flood-control operations that in the last decade have developed strikingly unusual features. The purpose is to introduce flood detention into the present advanced development of levees, floodways and channel straightening for confining flood flow.

The general picture

In the revised Mississippi River flood control plan (*ENR* April 4, 1935) provision was made for several detention reservoirs on the upper tributaries of the Yazoo River which enters the Mississippi near Vicksburg. Sardis Dam on one of these tributaries, the Little Tallahatchie River, will form the first reservoir of the system and have a flood-detention capacity of nearly 1,500,000 acre-ft. Geographically the dam is in Mississippi about 50 mi. south of the Tennessee line at Memphis, Tenn. The nearest railway towns are Sardis, 6½ mi., and Batesville, 11 mi. from the site. A construction road was built from Batesville.

The valley of the Little Tallahatchie is a little-developed flood plain well wooded in considerable areas but with limited large timber. The reservoir extends up the valley about 30 mi. from the dam, with an area of about 92 sq.mi. Its total capacity is about 1,570,000 acre-ft. but a permanent pool of about 92,000 acre-ft. will be maintained, reducing the flood-control storage to 1,478,000 acre-ft. or about 94 per cent of the reservoir capacity. The permanent pool will flood about 9,800 acres and it is planned to clear the land to 5 ft. above this minimum pool level; the remainder of the reservoir land area is to be left as it is. The reservoir capacity planned will control completely the maximum flood of record at the dam site.

Large dam required

The dam, of course, is the main construction operation and it is a large one. The total fill is 16,760,000 cu.yd. of which 13,815,000 cu.yd. are hydraulic fill. Next to Gatun Dam for the Panama Canal, Kingsley Dam under construction by the Central Nebraska Public Power and Irrigation District, and of course Fort Peck Dam, Sardis is the largest dam of record of the hydraulic-fill type. The dam and abutment dikes have a total length of 14,550 ft. (about 2¾ mi.) at crest elevation (312 ft. M.G.L.). The maximum height above streambed is 117 ft. An outline plan of the dam is shown by Fig. 2, and Figs. 3 and

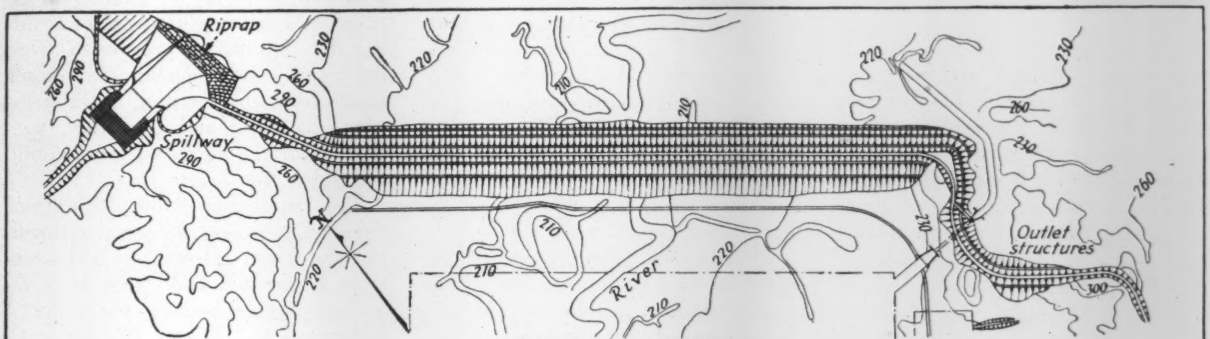

Riprap
Spillway
Outlet structures
River
N
220
230
260
290
210
300

FIG. 2 – PLAN OF DAM

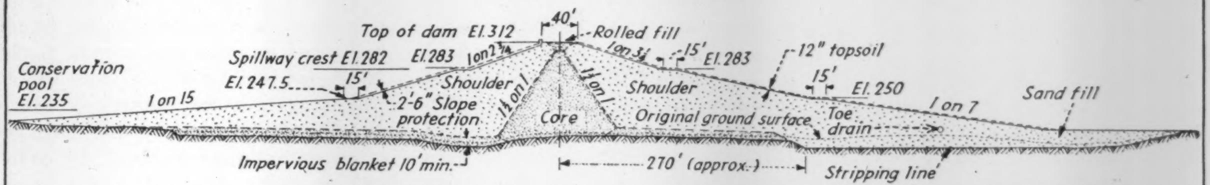

Top of dam El. 312
40'
Rolled fill
Spillway crest El. 282
El. 283
1 on 2¾
1 on 3½
15'
El. 283
12" topsoil
Conservation pool El. 235
El. 247.5
15'
1 on 15
Shoulder
2'-6" Slope protection
1½ on 1
1½ on 1
Core
Shoulder
Original ground surface
15'
El. 250
Toe drain
1 on 7
Sand fill
Impervious blanket 10' min.
270' (approx.)
Stripping line

FIG. 3 – SECTION MAIN EMBANKMENT IN STREAM CHANNEL

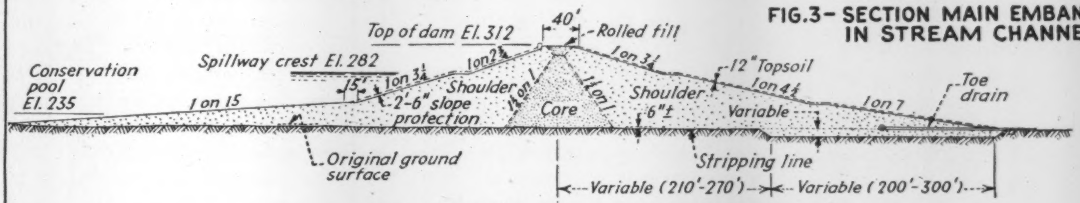
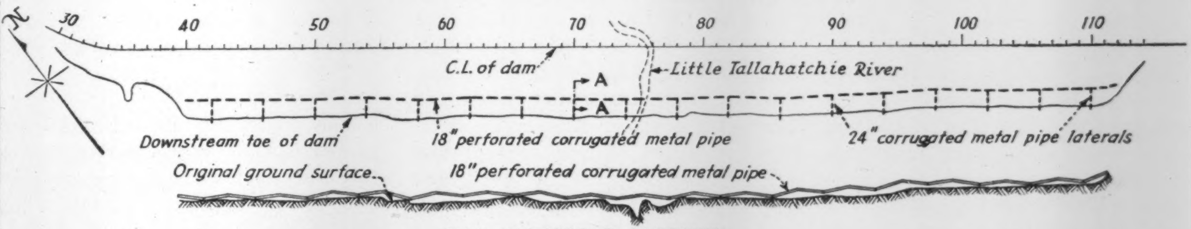
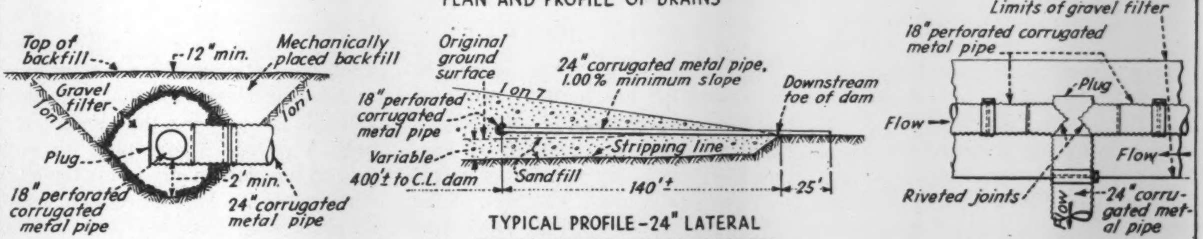

Top of dam El. 312
40'
Rolled fill
Conservation pool El. 235
Spillway crest El. 282
1 on 2¾
1 on 3½
12" Topsoil
1 on 4½
15'
1 on 3½
Shoulder
2'-6" slope protection
1 on 15
1½ on 1
1½ on 1
Core
Shoulder
6"±
Variable
1 on 7
Toe drain
Original ground surface
Stripping line
Variable (210'-270')
Variable (200'-300')

FIG. 4 – TYPICAL SECTION MAIN EMBANKMENT


N
30
40
50
60
70
80
90
100
110
C.L. of dam
A
A
Little Tallahatchie River
Downstream toe of dam
18" perforated corrugated metal pipe
24" corrugated metal pipe laterals
Original ground surface
18" perforated corrugated metal pipe

PLAN AND PROFILE OF DRAINS


Top of backfill
12" min.
Mechanically placed backfill
Gravel filter
1 on 1
1 on 1
Plug
2' min.
18" perforated corrugated metal pipe
24" corrugated metal pipe
Original ground surface
24" corrugated metal pipe, 1.00% minimum slope
1 on 7
Downstream toe of dam
18" perforated corrugated metal pipe
Variable
Stripping line
400'± to C.L. dam
Sand fill
140'±
25'
Limits of gravel filter
18" perforated corrugated metal pipe
Plug
Flow
Flow
Riveted joints
Flow
24" corrugated metal pipe

SECTION A–A

TYPICAL PROFILE – 24" LATERAL

DETAIL OF CONNECTION

FIG. 5 – TOE DRAINAGE SYSTEM

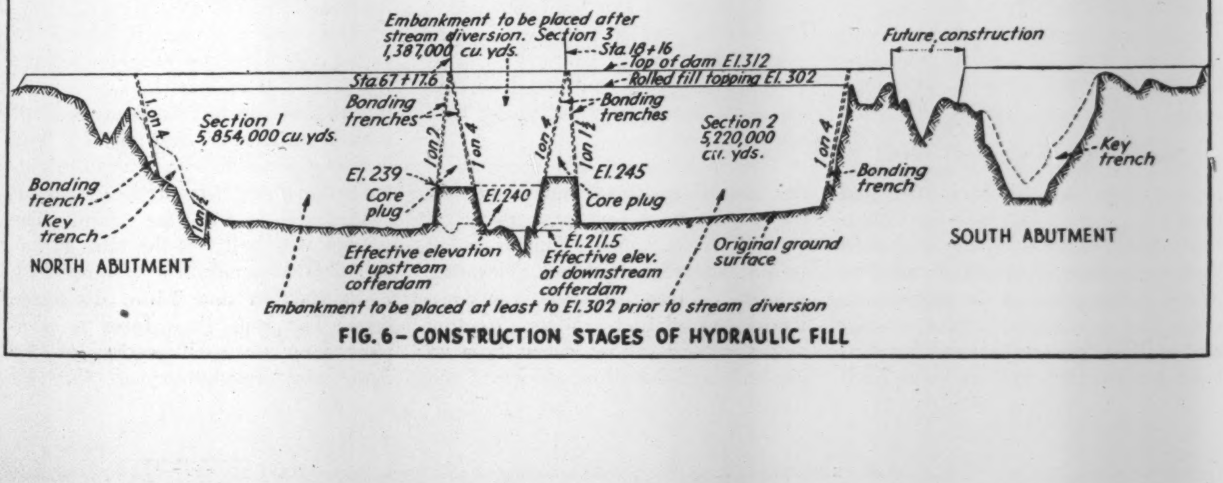

Embankment to be placed after stream diversion. Section 3 1,387,000 cu. yds.
Sta. 18+16
Top of dam El. 312
Sta. 67+17.6
Rolled fill topping El. 302
Future construction
Section 1 5,854,000 cu. yds.
Bonding trenches
Bonding trenches
Section 2 5,220,000 cu. yds.
1 on 4
1 on 2
1 on 4
1 on 4
1 on 1½
1 on 4
1 on 2
El. 239
El. 245
Core plug
El. 240
Core plug
Bonding trench
Key trench
Bonding trench
Key trench
NORTH ABUTMENT
Effective elevation of upstream cofferdam
El. 211.5
Effective elev. of downstream cofferdam
Original ground surface
SOUTH ABUTMENT
Embankment to be placed at least to El. 302 prior to stream diversion

FIG. 6 – CONSTRUCTION STAGES OF HYDRAULIC FILL

4 show two sections. In the stream the section, as shown by Fig. 3, is different from the typical section in including wider slopes and more particularly an impervious blanket over the streambed fill. The upstream slope protection will be noted. This work will require 98,500 cu.yd. of gravel blanket and 390,000 tons of stone riprap. The stone will be supplied by the J. L. Shiely Co. of St. Paul, Minn. The riprap and gravel will be placed by the Forcum-James Co. of Dyersburg, Tenn., and H. N. Rodgers & Son of Memphis, Tenn. Operations under these contracts are scheduled for the present season.

A distinctive feature of the section is the toe-drainage ditch and corrugated pipe toe drains. Excavation for the ditch, about 900,000 cu.yd., was done by contract and the pipe laying and backfill were a part of the hydraulic operation by day labor. General details of the drain pipe system along the main dam are shown by Fig. 5. Other details of the fill are quite conventional except that the hydraulic fill of the core will stop about 10 ft. below the crest of the dam and the remaining wedge of earth to the crest will be rolled fill.

The normal outlet for the reservoir is provided by control works at the south end of the dam. The particulars that perhaps should be noted are that the approach channel, which is largely under fixed pool level, has only a lining of rolled earthfill. The gate tower has four rectangular gates opening into a rectangular section which changes through transition sections to a horseshoe section in the 16x18½-ft. conduit through the dam. Flood overflow is provided for by a spillway around the north end of the dam. The design is of the chute type without crest control. The weir is curved and will be 400 ft. long with its top at El. +282 and at superflood reservoir pool level will discharge 132,000 sec.-ft. The discharge enters the river about a mile below the dam.

Construction work divided

The dam structures as outlined divide somewhat logically into abutment dikes, outlet, spillway and main dam embankment to which may be added preparation of the main damsite. The special structures (outlet and spillway) were planned for contract construction and are being built by contract. The abutment dikes and virtually all of the work of preparing the site for the main dam embankment were also awarded to contract. Bids for the hydraulic fill greatly exceeded the 25 per cent differential allowed as compared with the estimate of the district engineer and this work was taken over for hired-labor execution.

Functionally, the earthwork for the dam divides into rolled fill by contract, and hydraulic fill and incidental rolled fill by day labor. Roughly divided, the rolled-fill part of the work includes 3,680,000 cu.yd. of excavation and 2,945,000 cu.yd. of compacted fill. The hydraulic fill includes an estimated 6,493,000 cu.yd. in the north wing of the dam, 5,802,000 cu.yd. in the south wing and 1,520,000 cu.yd. in the closure section between the wing sections.

The progress of work on the contract sections as of Jan. 6, 1939, was as follows: Rolled-fill abutment dikes and excavation, built by the Hooper Construction Co., Jacksonville, Fla., contractors, had been completed. On the spillway work by the same contractors about 14 per cent of the excavation (320,000 cu.yd.) had been completed. On the outlet structures, E. J. Albrecht Co., Chicago, Ill., contractor, the completed volumes and percentages were: Excavation 438,000 cu.yd. or 81 per cent; rolled fill 100,000 cu.yd., or 23 per cent; concrete 4,700 cu.yd. or 21 per cent, and pile driving 60 per cent.

Controlled rolled fill

The principal technical interest in the rolled fill lies in the control of materials, placement and compaction. In this regard the contractors contributed largely by providing ample and good equipment. The bulk of the excavation is in spillway and dike construction, and in preparing the emplacement for the main dam which consists of widely scattered operations that vary from heavy rolled dike construction and toe-drain excavation to shallow stripping and scattered patching.

The variety and wide spread of the operations, incidentally, indicate the good reason for the contractor's variety of equipment. This included power shovels, draglines, elevating graders, tractor-trailer wagons, trucks, sheepsfoot rollers, tractors and scrapers—about every type of general earth-handling machines and particularly plenty of hauling units. In general the operations, after building the cofferdikes, progressed from the south end, placing the larger south dikes and working north stripping, patching and trenching, preparing for the south wing hydraulic fill which was begun first.

The requirements for placing and compacting rolled fill were uniform. Borrow areas selected by soil tests were designated and check tests on pit samples are made as the material is opened up. In the fill, the earth is spread in 6-in. layers with attention to surface roughening for bond and other unusual precautions. Each layer is compacted by sheepsfoot rollers at optimum moisture content. Needle tests for density are made as often as necessary to check the compaction being obtained. The sheepsfoot rollers are 1,200-lb. tractor-hauled machines with 7-in. legs and two feet per square foot of roller surfaces. Six passes of the roller are required and more if additional work is necessary.

Roller compaction is employed in all places where it is possible; where it is impracticable the material is deposited in 2-in. layers and compacted by mechanical tampers.

The hydraulic fill

The hydraulic fill of the dam proper is being made in three parts, two wing sections and a closure section. Filling began in the south wing, Sec. 2, Fig. 6; the north wing (Sec. 1) is now being pumped and the closure section (Sec. 3) will be filled when the outlet works are completed to take the river flow that now goes through the gap for the closure section. A rolled-fill core plug on each side of the closure gap holds the ends of the core pool in the wings. These barriers were built up part way as shown by Fig. 6 by the contractor for the rolled-fill operations just described, and are carried higher by rolled fill with the progress of the hydraulic fill in the wings.

The fill material is sand and silt with a small per cent of clay and is being pumped by a hydraulic cutter-head dredge from a borrowpit downstream from the dam. The dredge was built on the site. It has two 3,000-hp. electric pumps with 27-in. suction and 24-in. discharge lines. The pipe lines form a complete loop on each section of the dam and regulation of the fill is accomplished entirely by shutters in the pipe lines that encircle the core pool. Surplus pool water is handled over the bank by pump barges. Distribution of fill and control of beach and core formation follow modern practices but include none that are unusual.

The progress on the hydraulic fill to Jan. 1, 1939, has been on Sec. 2 (begun first) 5,500,000 cu.yd. placed bringing the shell to elevation +298 M.G.L. In Sec. 1, 300,000 cu.yd. have been pumped including toe-drain backfill. In all, 45 per cent of the hydraulic fill in the main dam is completed.

Direction of work

Sardis dam is being built under the direction of Brig.-Gen. Harley B. Ferguson, president, Mississippi River Commission. Lt.-Col. Raymond G. Moses, Corps of Engineers, is district engineer, Vicksburg, Miss., with Capt. W. H. Hastings as executive assistant. From 1936 until his death, Nov. 24, 1938, Major John B. LaGuardia, was project engineer in direct charge at the dam. He was succeeded by Capt. Karl B. Schilling, now in charge.

The project was designed in the Vicksburg district office. The consulting engineers are W. H. McAlpine of the office of the Chief of Engineers, Washington, D. C. William Gerig of Arkadelphia, Ark., J. D. Justin of Philadelphia, Pa., and O. N. Floyd of Dallas, Tex. The late Louis C. Hill of Los Angeles, Calif., was a member of the board from the inception of the work in 1936 until his death on Nov. 5, 1938.

Balcony Girder has Three Webs

A. M. YOUNG

Seattle, Wash.

Design of a concrete girder of 84-ft. span departs from the conventional T section with notable success

AN IMPROVEMENT over the conventional concrete balcony girder of T-section was developed in working out the design for the auditorium in the recently completed high school at Bellingham, Wash. where the requirement was for a clear span of 84 ft. A comparison of cross-sections showed that not only would a three-web girder have a much stiffer section for resisting torsion than would a T-section, but balcony framing could be arranged so that transverse moments produced by live loads on the cantilevers only would be resisted by the beams on the rear side of the girder which develop resisting reactions at the corridor wall. The unusual width of the three-web girder also has the substantial advantage of directly carrying a considerable percentage of the total balcony floor load and shortening the spans of the cantilevers on the forward side as well as the upper and lower beams framing into the girder on the rear side. A basic assumption in the design of this girder is that it acts as a single unit; its three webs are so constructed as to distribute and equalize the loads.

The girder has an overall length of 88 ft.; is 12 ft. wide and 8 ft. deep. The top slab is 18 in. thick and the three 16-in. webs are spaced 4 ft. apart. Into this girder are framed the 12-in. webs of the six balcony cantilevers, 14 ft. 2½ in. on centers, in such a way that they constitute transverse diaphragms for the girder. Midway between the diaphragms are additional 8-in. cross webs.

At mid span the balcony facia is 19 ft. out from the girder and this distance increases to 30 ft. 8 in. at the auditorium side walls. Reinforcing in the girder webs consists of bars 2 in. square placed in four layers of three bars each. The three bottom bars are straight and continue from end to end; the others bend up at 45 deg. to the top of the girder for web reinforcement.

Calculations of girder stresses allowed for six ventilating duct openings of varying size located in the middle third of the span in all three webs. An opening 21 in. square also was required in the webs of one of the cantilevers a few feet out from the main girder. The 1:2:3 concrete mix was assumed to have a 28-day strength of 2,900 lb. per sq. in. and was found to develop a cylinder strength of 4,400 lb. per sq. in. Working stress for the concrete in flexure was 1,200 lb. and for the intermediate grade reinforcing 20,000 lb. per sq. in.

The design has proved to be satisfactory in every way. The girder entailed more cost for form work and used more concrete than the convention T-type but these items were far outweighed by the resultant economy.

Floyd A. Naramore, Seattle, was architect of the building; the writer prepared the structural design. Henrickson-Alstrom Co. were contractors.

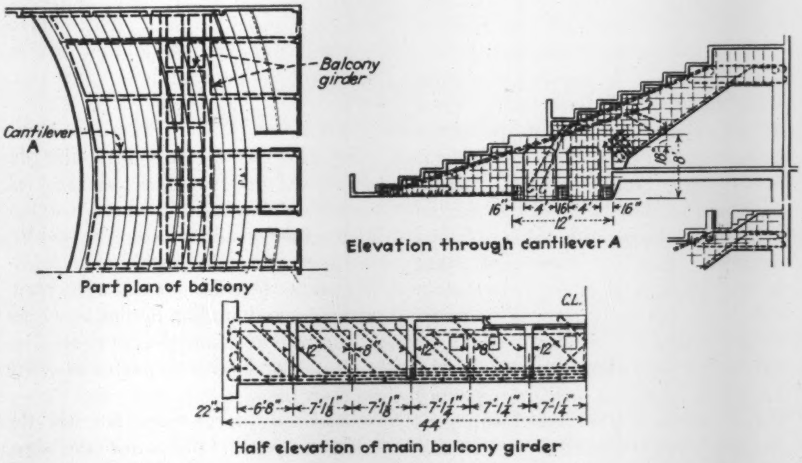


Fig. 1. Dimensions and details of the three-web balcony girder in the Bellingham high school auditorium.

Pollution Control—By Whom?

I. M. Glace and C. F. Browning

Consulting Sanitary Engineer
Harrisburg, Pa.

Public Health Engineer
Health Dept., Washington, D. C.

Contents in Brief—Question is raised as to why sole responsibility for the control of stream pollution should be fixed on state health departments. The authors hold that the job is one for a board composed of representatives from conservation, recreation and other interests as well as health departments.

Those familiar with public health progress in the last quarter century give well-deserved credit to the state sanitary engineers for their part in this achievement. They have done a notable job in promoting the use of safer water supplies and the abatement of stream pollution. But has not the time come to relieve state health departments of the sole responsibility concerning the installation of sewage treatment facilities? The abatement of sewage pollution is more than a health problem.

Prior to 1910 when the necessity for the treatment of sewage was establishing a feeble hold in the public mind, stream pollution abatement was almost entirely a function of the state health departments. In hundreds of cases sewage was being discharged untreated upstream from the intakes of public water supplies, and as a consequence typhoid fever was rampant. This condition of untreated sewage discharge still exists far too widely.

The major factor

What then has been the major factor in the advancement of public health? The answer is, of course, the installation of water filtration plants and the almost universal use of chlorine as a disinfectant. Protection against sewage discharges has been secured mainly through the efficient treatment of water rather than through the abatement of pollution.

The continued importance of pollution abatement in respect to public health is not to be minimized. But treatment of sewage is not the major health problem that it was before filter plants and chlorine disinfection were in such general use. It has become a problem in which a number of other factors or agencies are or should be concerned—economics, recreational use, aquatic life, flood control, irrigation, the elimination of nuisances, and esthetics. These other factors have always been with us but their importance has been obscured by the tremendously emphasized health angle.

Who makes decisions?

Despite this vital change in sanitation and environmental conditions the administration of anti-pollution activities is still saddled almost entirely in this country on state departments of health. To them is left largely the unpopular decision as to where and when sewage treatment works must be installed and the degree of treatment which is necessary. In many cases, consulting engineers seem to make the decision as to degree of treatment but it will be found that their judgment has been markedly influenced by the opinion of the state sanitary engineer.

We protest this practice as being unfair to health departments and not in the best interests of pollution abatement nor of public health administration. This policy has resulted —generally speaking—either in no treatment because the state sanitary engineers are not convinced that money spent for sewage treatment will bring adequate returns in terms of protection of public health; or else in the installation of works designed to abate a visible nuisance with a degree of treatment insufficient properly to remove the undesirable condition.

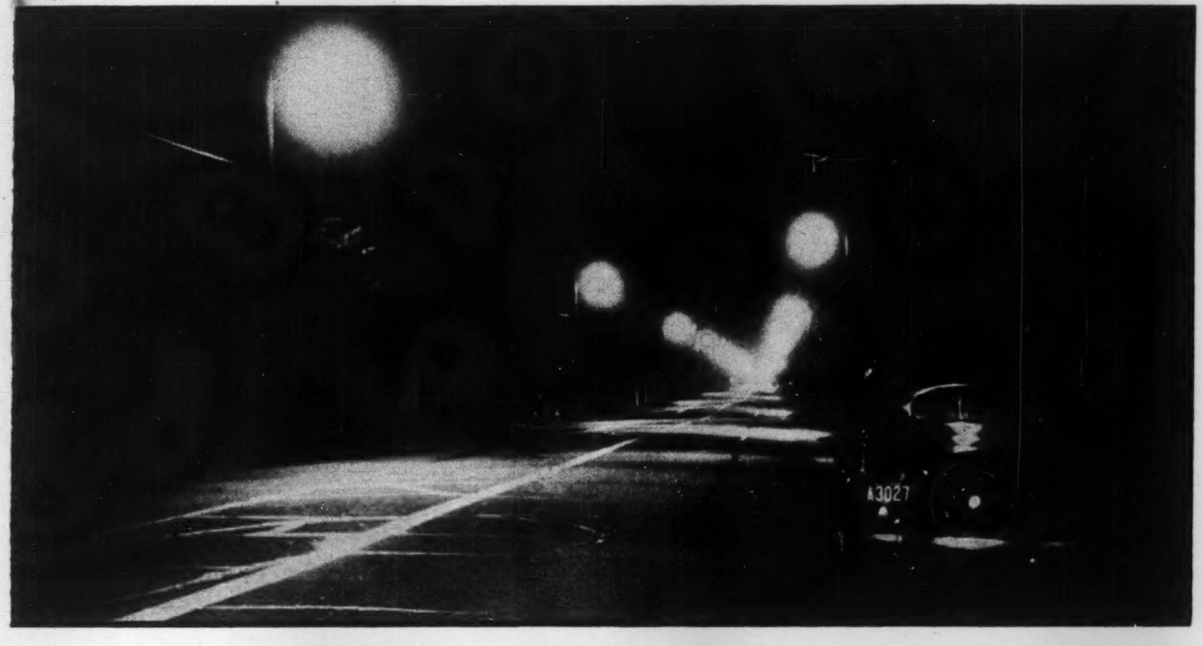
Because of the failure to recognize this basic change in environmental conditions there have been installed scores of so-called sewage treatment works which scarcely merit the name. The time is at hand to revise our standards on treatment and to be honest with our clients, the public. Let us advise them that adequate treatment is something more than screening and settling, and that the fullest and best treatment is none too much for the average condition; and lastly, that pollution abatement is not entirely a health problem.

Above all let us remove from the shoulders of state health departments the sole responsibility and burden of these ill-received decisions, namely, which communities shall spend their money for treatment, when they shall do so, and how much they shall spend. Let us place the responsibility where it belongs—on an agency where conservation, recreation, and industrial interests as well as public health men are represented. This does not mean that the problem need be taken entirely from the health departments. The sanitary engineers of these agencies are trained in the science of sewage treatment and to them should be assigned the duty of reviewing and approving the plans and projects. But they should not be required to say where, when, and how much treatment is necessary.

What to do

Several of the states have already recognized the fact that treatment of sewage and industrial wastes can no longer be considered solely a health problem and have established sanitary water boards, conservation commissions, and similar bodies in which a number of state departments, including the health departments, are represented.

Obviously it is time for all the states to reach the same decision, to reorganize their anti-pollution activities and to amend and strengthen their pollution laws.



SAFETY LIGHTING ON WHITE HORSE PIKE FOR 52 MI. FROM CAMDEN TO ATLANTIC CITY, N. J.

Safety By Lighting

E. R. SHERBAUM

Electrical Engineer, State Highway Department, Trenton, N. J.

***Contents in Brief**—The New Jersey state highway department has made rapid progress in a campaign to reduce night accidents by lighting sections of road where darkness offers special hazards. Selected sections were set up as accident laboratories and accident occurrence before and after lighting was analyzed. A cooperative plan of financial and engineering assistance to cities and counties is in active promulgation. White Horse Pike from Camden to Atlantic City, is lighted its full length.*

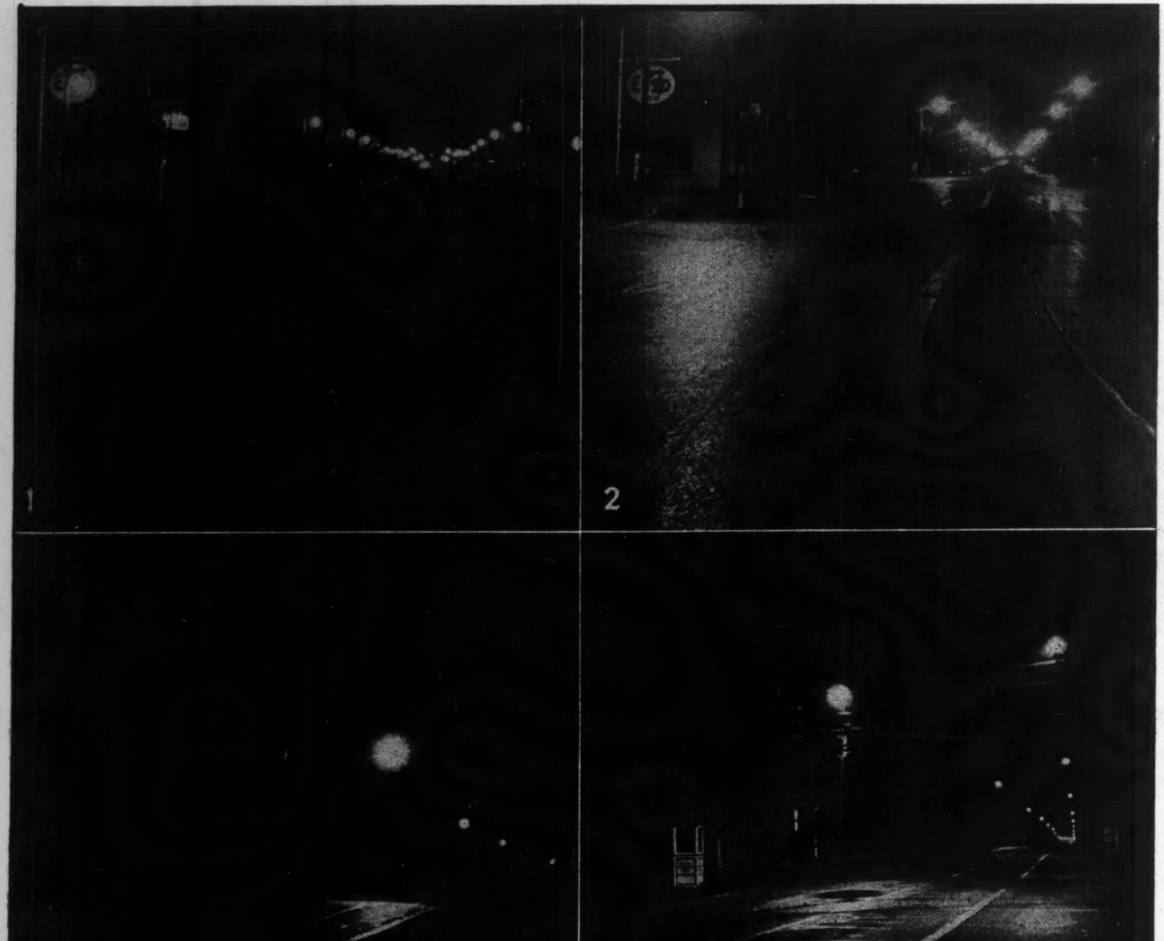
ENGINEERING PROVISION for highway safety in New Jersey involves several activities—lighting is only one of them. But lighting is the activity that will be emphasized now and the results, it is believed, justify this emphasis. In general the safety provisions include policing, highway lighting, traffic signals, divided highways, lane markings, grade separations, guardrails, electric and reflectorized direction signs, white reflecting curbs, circles and all other known safety features.

In the campaign against night accidents, after studying all available data on the subject, the highway department engineers decided to find out the actual relationship between highway lighting and the night-accident rate in New Jersey. There did not seem to be available anywhere "before" and "after" data of this sort for exactly the same type of highway, under similar weather and traffic conditions and for the same months of the year. The department accordingly started what it chose to call its accident laboratories.

What the tests showed

Three stretches of state highway were selected as accident laboratories. On these sections 24-hr. accident patrols were inaugurated, three men alternating every eight hours, riding back and forth continuously, over about 5-mi. stretches, marked out in stations of 200 ft. so that accidents could be accurately spotted. Traffic counters were stationed at strategic locations to record traffic volumes, so that ratios of accident rate and traffic flow could be established. The men on accident patrol gather complete information concerning the accident, its cause, the condition of the car and driver, the weather, the condition of the pavement and all data pertinent to a proper analysis of the cause, and this information is forwarded fully to the main office in Trenton, where especially trained safety engineers carefully analyze the contributing factors and classify the accident under one of several well-defined types.

In this way, the principal causes of the majority of the accidents on each type of road can be ascertained, which in turn permits various preventatives to be prescribed, such as divided highways, white indented curbs, highway lighting, traffic signals, signs, etc.



SAFETY BY LIGHTING IN NEW JERSEY

(1) Belmar, N. J. with 250-cp. street lamps and (2) after 600-cp. lights 200 ft. apart had been installed. (3) White Horse Pike at Elwood, N. J. before light and (4) after modern lighting was installed. (5) Avon, N. J. with 250-cp. street lamps and (6) after 6000-lumen lamps 25 ft. high had been installed 200 ft. apart.

Three stretches of the highway system were selected for the experiments, because of the various types of construction that they represented and the different types of traffic that they carried. The data gathered and analyzed on each project are indicated in the accompanying tabulations. The lighted period has not been sufficiently long at this time to make absolutely conclusive deductions, but by comparing the before and after data, the trends can easily be observed.

So that comparative studies can be made of incandescent and sodium lighting, one mile of 6,000-lumen units has been installed on White Horse Pike at Absecon, and in addition, fifty 6,000-lumen units are being installed on Routes 2 and 6 at Bendix Airport, and 88 on Admiral Wilson Boulevard between the Camden Airport Circle and Twelfth St., Camden. On these installations, luminaires of various manufacturers have been placed alongside each other so that, in addition to the studies of the sodium vapor light itself, accurate cost data may be compiled on the products of the various manufacturers.

Cooperative plan inaugurated

In 1937, for the first time in the legislative history of New Jersey, Commissioner Sterner succeeded in having set aside $150,000 to give financial assistance in the way of reimbursement to municipalities for lighting improvement. After an informal conference with representatives of the municipalities and safety and lighting engineers, the consensus of opinion of the majority was that rather than distribute these moneys equally among all the municipalities where highway lighting on state highways might be required, sections of highways be selected regardless of municipal boundary lines, where, from a standpoint of traffic volume and accident frequency, it was felt that highway lighting would curtail the largest per cent of the vast number of accidents.

The necessity for the lighting of traffic circles, underpasses, bridges and important intersections was taken for granted, as these were easily recognized as potentially dangerous and, with the exception of the last, the state highway department bears the complete cost of installation and maintenance.

In the case of important intersections and sections of straightaways where either the night-accident rate or the traffic volumes warrant it, the highway department shares with the county or municipality the installation and maintenance costs of such installations as can be justified.

Under this policy, if on any section of the state highway system the state highway engineers find abnormal traffic congestions or high night-accident frequency and it is believed that, for increased safety, uniform highway lighting is essential, then they provide lighting to the degree where "normal darkness" is eliminated.

From studies recently completed by the state highway accident laboratory, it was found that 2,500-lumen lamps, staggered about 200 ft. apart, using 25-ft. mounting heights and approved highway lighting fixtures, on mast arms of sufficient length to bring the unit at least 3 ft. over the edge of the paved roadway, produced sufficient illumination on light-colored pavements to silhouette objects on the highway sufficiently to permit an automobile driver obeying the state motor vehicle laws to operate a car in good condition in comparative safety.

PROJECT NO. 1

New Jersey Route 25 — Elizabeth to Newark Viaduct. Length, 3.33 mi. On Aug. 1, 1937, lighting units were turned on, using 400-cp. lamps on 400-ft. centers, and on No. 1, 1937, the spacings were reduced to 200-ft. and the lamp sizes to 250-cp. The observations were as follows.

400-cp.— 400-ft. centers

		Accidents Non-Fatal	Fatal	Avg. Traf. Vol.— 16 hr.
Unlighted — Aug. 1 to Oct. 31, 1936	Day	82	1	44,500
	Night	20	0	
Lighted — Aug. 1 to Oct. 31, 1937	Day	56	0	50,700
	Night	28	1	

The traffic volume in 1937 increased 13.68 per cent, and the night accidents increased 40 per cent.

250-cp.— 200-ft. centers

		Accidents Non-Fatal	Fatal	Avg. Traf. Vol.— 24 hr.
Unlighted — Jan. 1 to July 31, 1937	Day	57	0	63,800
	Night	61	3	
Lighted — Jan. 1 to July 31, 1938	Day	110	8	70,200
	Night	59	0	

The traffic volume in 1938 increased more than 10 per cent, night accidents decreased and fatal night accidents were eliminated.

The abnormal six-lane dark-surface roadway absorbs much of the light of the 250-cp. units and does not reflect sufficient light to give proper visibility to motorists ordinarily traveling at high speed on this highway at night time. The intensity of these lamps has now been increased from 250-cp. to 400-cp., to give motorists better visibility and to permit traffic to move with greater safety. The observations will be reported as soon as the data are obtained.

PROJECT NO. 2

New Jersey Route 4 — From George Washington Bridge to Paterson. Length, 12 mi. On Dec. 4, 1937, lighting units were turned on, using 400-cp. lamps and 600-cp. lamps, on 200-ft. centers in the built-up areas and 400-ft. centers in the rural areas. The observations were as follows:

		Accidents Non-Fatal	Fatal	Avg. Traf. 16 hr. Count 3-day
Unlighted — Jan. 1, 1937 to Sept. 30, 1937	Day	138	2	55,577
	Night	101	5	
Lighted — Jan. 1, 1938 to Sept. 30, 1938	Day	161	3	58,611
	Night	74	2	

The traffic volume was increased 5.46 per cent in 1938; the night accidents decreased 26 per cent in 1938, and fatal night accidents decreased 60 per cent.

PROJECT NO. 3

New Jersey Route 43 (White Horse Pike) — Absecon to Egg Harbor. Length, 11 mi. On May 13, 1938, lighting units were turned on, using 400- to 600-cp. lamps on 200-ft. centers. The observations were as follows:

		Accidents Non-Fatal	Fatal	Avg. Traf. Vol.— 16 hr.
Unlighted — May 24 to Sept. 24, 1937	Day	14	0	9,300
	Night	18	3	
Lighted — May 24 to Sept. 24, 1938	Day	28	0	12,650
	Night	18	0	

Traffic increased 35 per cent in 1938 and fatal night accidents were eliminated during this period. During the Fourth of July holidays, for the first time in history, this stretch of Route 43 experienced an "accident holiday," for not a single night accident was recorded.

Many municipalities, where installations were contemplated, volunteered to enter into contracts with the highway commissioner on the basis of obtaining as state aid the equivalent cost of 2,500-lumen lamps and then increasing the lamp sizes to 4,000 lumens or 6,000 lumens, as they deemed necessary, or were able to pay for. It was generally conceded in the case of municipalities that as the additional hazards existing were created by local automobiles and pedestrians entering or leaving the highway, the municipality should share in the cost of eliminating the hazard. It was also felt that it should provide light on the highway at least on a par with the light furnished on other streets of equal importance, in return for the local taxes collected, particularly where there was improved real estate fronting on the state highway.

Longest lighted road

The lighting of the White Horse Pike, New Jersey Route No. 43, from Camden to Absecon, has been recently completed, and is now the longest continuously lighted section of highway in the United States. On this 52-mi. section traversing 22 municipalities, there are installed 192 units of 6,000-lumen capacity, 196 4,000-lumen units, and 812 2,500-lumen units (all incandescent) of the new "acorn" type luminaire; also, 24 6,000-lumen sodium units of different types were installed in adjoining sections near Absecon, so that comparisons of the various fixtures could be easily made. This lighting is paid for partly from state highway funds and partly by the municipalities through which the route passes.

In addition to the 1,200 lighting units on the White Horse Pike, about 4,800 incandescent units are under contract to be installed in various municipalities under state-highway-reimbursement programs. Plans have been completed for installing, before the summer of 1939, additional safety highway lighting units at every important county road and state highway intersection in the state. This program will complete the installation of lighting units throughout the state at all important crossroads and in the congested areas.

In sixteen counties where modern state-highway safety lighting installations have been made, the highway death toll at night in 1938 was 191 less than the previous year for the first eleven months. Records disclose 154 persons died, 2,538 were seriously injured in 2,831 accidents in 1938, as compared with 345 deaths, 3,191 seriously injured in 3,504 accidents during the 1937 period, a decrease of 60 per cent in deaths, 26 per cent in injuries and 23 per cent in accidents. An impressive contrast is that the fatalities, injuries and deaths in the daytime on these same sections of the state highway system remain about the same. In the remaining five counties where lighting installations were not made during 1938, the deaths, persons injured and accidents were not materially reduced in the daytime or nighttime period.

There has been an actual saving of $76,804 in lighting costs to the taxpayers of the various municipalities and, in addition, they are enjoying the advantages of a modern highway lighting system. The reduction in injuries and deaths at night as a result of the New Jersey state highway department's safety program has been accomplished at a cost to the state and the municipalities of less than $500 per person saved from injury or death.

Retractable Trucking Tables Span Tracks Between Warehouses

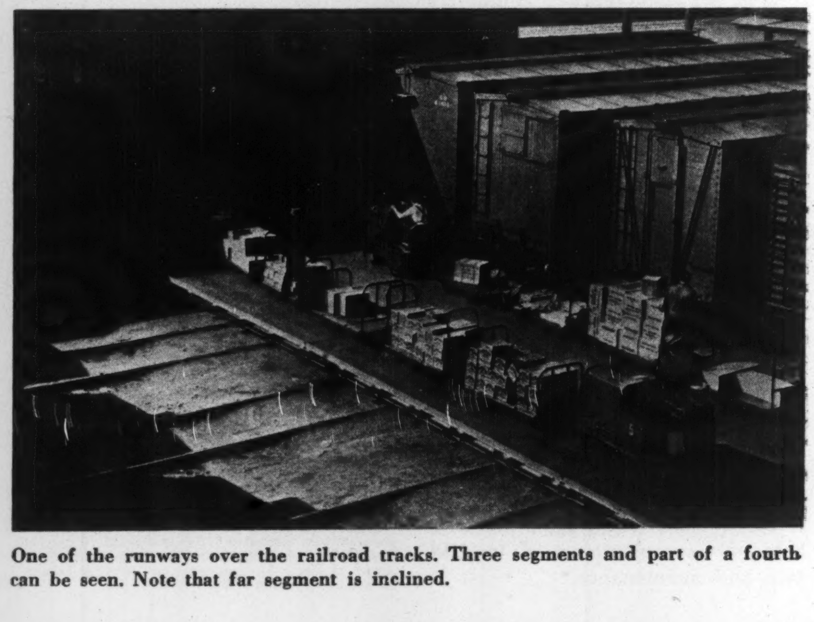
***Contents in Brief**—Storage-battery tractors and their trailers are saved the jolting of an 8-track grade crossing between warehouses by the use of trucking tables that retract under the floors to clear the sidings.*

MOTOR-OPERATED trucking tables or runways are now used by the Southern Pacific Co. at San Francisco where it was necessary to provide convenient access over railroad sidings which separate the company's warehouses. The runways are in service for certain hours daily and exchanges between warehouses are made during this time with storage-battery tractors hauling trains of small industrial cars. Later, the segments of each runway are uncoupled and retracted into chambers beneath the floor of the warehouses, leaving the railroad sidings clear for switching.

Prior to the installation of these runways it was necessary for the trains of four-wheel warehouse trailers to be hauled from warehouse floor level down to the street level, thence at grade across eight railroad tracks and up another ramp into the adjoining warehouse. Now freight cars are spotted so as to leave the runways clear; then the trucking tables are extended over the tracks to form a direct roadway between warehouses. This reduces the grades to be negotiated and avoids the necessity for hauling the small-wheeled platform cars over the tracks.

Each runway consists of five segments. Because the warehouse widths differ, two segments are retracted under the narrow shed and three under the wide shed. A 220-volt, 2-hp. geared motor on the end segment, operated by remote control, provides motive power for extending and retracting each runway at the rate of 20 ft. per minute. Each of the five segments is 24 ft. long by 17 ft. 4 in. wide. They are built of structural steel and operate on 14-in. flat wheels running in 6-in. steel channel rails. Limit switches automatically stop the segments in exact position when they are being moved into or out of the chambers. The track on which the segments operate is practically level. After moving out of the chambers it is necessary that the end of the segment nearest each warehouse be raised to bring it up to warehouse floor level. This lifting is accomplished by a 3-hp. motor beneath each end segment, which operates two lifting jacks on the end of the segment to be tilted. Motors used for the lifting jacks, as well as for tractive power, have limit-switch control for operation in both directions. Thus only push-button controls are needed.

The runways were designed for the Southern Pacific Co. by the Soule Steel Co. of San Francisco, by whom the mechanism has been patented.



One of the runways over the railroad tracks. Three segments and part of a fourth can be seen. Note that far segment is inclined.

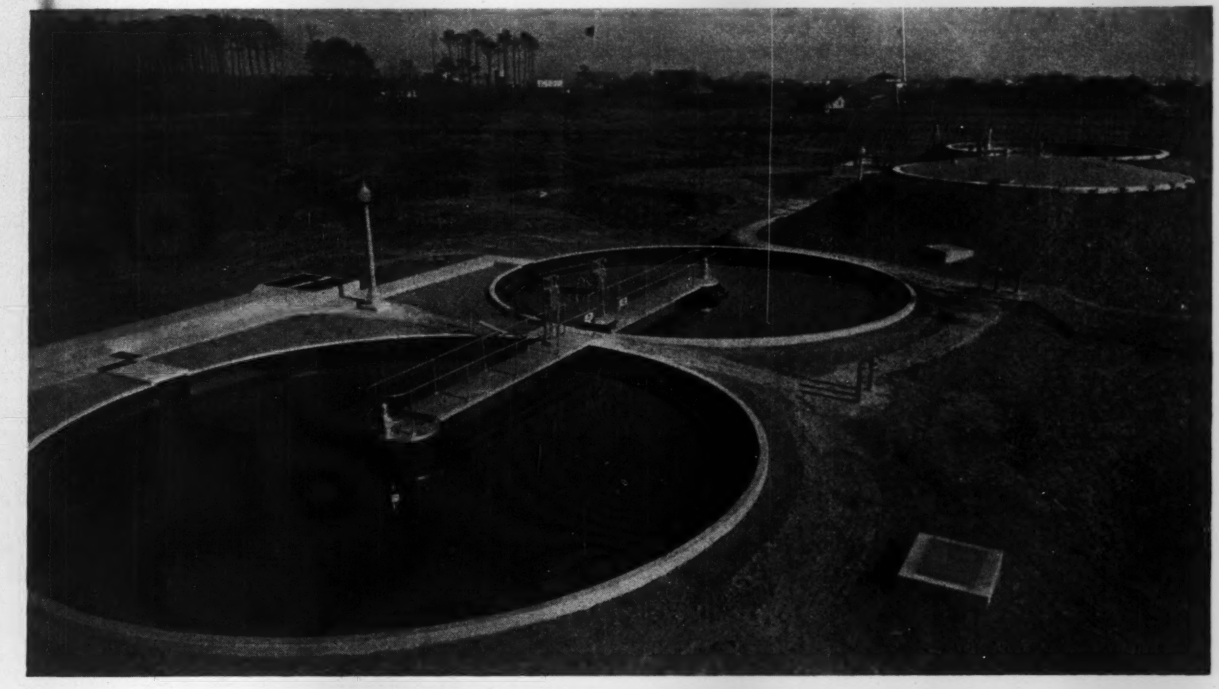


FIG. I. PRIMARY CLARIFIERS AND SLUDGE DIGESTION TANKS AT VIRGINIA BEACH.

Sewage Treatment For a Seaside Resort

W. Martin Johnson

Sanitary Engineer, Wiley and Wilson, Consulting Engineers, Lynchburg, Va.

***Contents in Brief**—A sewage disposal plant with unusual range of flexibility has been built at Virginia Beach, Va., where the population varies from 2,500 in winter to 40,000 in summer. A high degree of treatment is provided to avoid contamination of the bathing beaches and shellfish beds.*

With ocean front beaches so easily accessible because of improved transportation facilities, utility services at coast resorts are subject to unusual peak demands. This is particularly true in the case of sewage disposal, and treatment facilities of special flexibility must be provided because of the wide variations in population at different seasons of the year. Nowhere along the Atlantic Coast is this variation more pronounced than at Virginia Beach, Va., where the population ranges from 2,500 in the winter to as high as 40,000 people in the summer season.

Recently completed is a trickling-filter sewage treatment plant designed to meet these unusual load conditions. During periods of low flow operation the plant will function with a single clarifier and provide complete oxidation on the trickling filter. To accommodate maximum flows, the plant is provided with additional clarification tanks and chemical precipitation facilities, and the trickling filter will then be operated at a high dosage rate to secure partial stabilization only. The digestion tanks are of sufficiently large capacity so that sludge can be stored for stabilization during the winter period.

For a number of years sewage at Virginia Beach was emptied into Linkhorn Bay immediately in the rear of the beach community. Sludge accumulations in the shallow water, which is subject to a tidal flow of only a few inches, and the lack of fresh water dilution caused a nuisance. Eventually a sedimentation basin, similar to the Doten tank developed for military camps, was placed in service.

This tank has been grossly overloaded, and although the application of chlorine aided in the control of odors from the affluent, treatment facilities were far from adequate. Furthermore, it was customary to remove sludge from the tank before and after the summer season, this being accomplished simply by discharging the sludge, in various stages of digestion, into the bay. These discharges created a septic condition in this body of water, with the resulting ordor nuisance in evidence for a considerable distance in the direction of Chesapeake Bay as well as along the ocean front. And as the pollution advanced into the bay it resulted in the condemnation of shellfish beds.

When engaged to make a report on corrective measures the consulting engineers for the town considered the possibility of discharging the plant effluent into the Atlantic Ocean as well as into the bay. Partly because of the objections of property owners along the beach front the idea of ocean disposal was abandoned. Another consideration favoring the discharge of the effluent into the bay was the fact that the ocean floor, for some distance offshore, consists of fine sand which shifts with the tides and storms to such a great extent that there would have been a constant danger of damage to a sewer outfall line. Finally, the expense of constructing a suitable outfall would have amounted to a sum closely approximating that of the sewage treatment plant itself. Even then, it would have been necessary to give a high degree of treatment to an effluent discharged offshore in order to preserve property values and prevent contamination of the bathing, sport fishing and recreation beach.

Type of plant

In view of the large variation in flow and the need for a high degree of treatment, a special problem in plant design was presented. Among other things, it was desired that the disposal facilities provide simplicity of operation during the winter months and that the units be of a type which were readily convertible for use during periods of high flow.

DESIGN AND ENGINEERING DATA

Treatment: (Winter operation) Pre-chlorination, bar screening, grit removal, primary clarification (secondary clarification optional), trickling filter, chlorination, final clarification, sludge digestion, sludge drying on beds. (Summer operation) Pre-chlorination, chemical sludge addition, bar screening, grit removal, primary flocculation and clarification, flash mixing, secondary flocculation and clarification, aeration by trickling filters, post chlorination, final clarification, sludge digestion, sludge drying on beds.

Plant Capacity: 0.3 m.g.d. at winter population of 2,500 and 3.0 m.g.d. at peak summer population of 40,000.

Screens: Duplicate hand-raked bar screens.

Grit Removers: Tank detritor with grit cleaning and organic return mechanism.

Metering Devices: Parshall flume with indicating and recording equipment.

Chemical Mixing Tanks: 2 tanks each 11x27x9 ft. with paddle flocculators and pumping type flash mixer.

Primary Clarifiers: 2 units ea. 40 ft. dia. by 7 ft. deep with scum and sludge collectors.

Secondary Clarifier: 60 ft. dia. by 7 ft. deep with scum and sludge collectors.

Trickling Filter: 120 ft. dia. by 5 ft. stone depth, variable flow distributor arms.

Final Clarifier: 50 ft. dia. by 6.5 ft. deep with scum and sludge collectors.

Digestors: 2 units ea. 40 ft. dia. by 16 ft. deep (one with fixed and one with an expanding gas cover) heat exchanger and circulating equipment.

Chemical Feeders: 1 manual and 1 automatic chlorinator. 1 manual and one automatic dry lime and chemical feeder, lime slurry tank.

Sludge Drying Bed: 50x100 ft., fitted with glass enclosure.

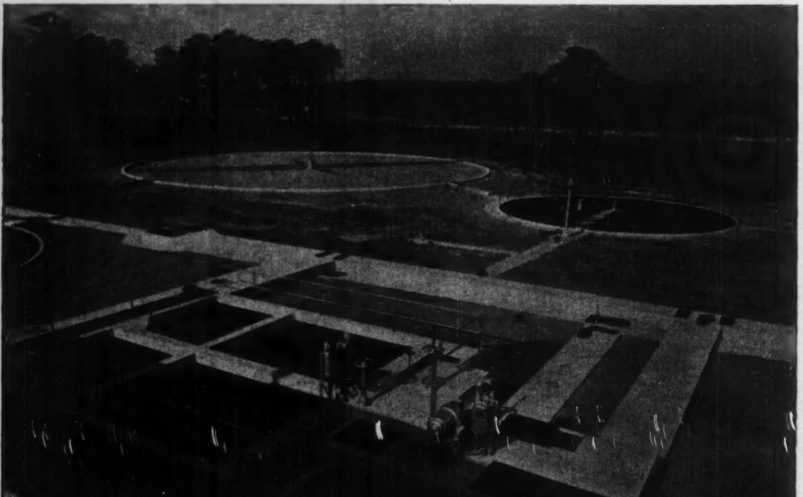


Fig. 2. **Flash mixer and flocculators, and in the background the trickling filter and a final clarifier.**

At the same time it was essential that the capital investment in the plant be kept at a low figure.

The plant designed to meet these requirements is so arranged that with the seasonal variation of from 300,000 gallons per day in winter to 3,000,000 g.p.d. in summer, the operation can be easily adjusted to take care of such changes, and a uniformly high grade effluent can be produced under all conditions. The plant units and the manner in which they function are as follows:

Raw sewage from all sources is collected at a central point from where it is pumped to the plant. Here it first enters a screen chamber in the control building. The screens are of the bar rack type with 1-in. clear openings and they are hand-cleaned. The screenings are drained, discharged into a hopper and then delivered to the grates of a gas-fired incinerator boiler.

Screened sewage passes into a grit chamber equipped with cleaning and removal equipment. Grit removal is an essential part of the treatment process because of the large amount of sand which reaches the sewers from the numerous bath houses, and also from surface water washing into street manholes.

From the grit chamber the effluent passes through a Parshall flume which measures the flow and also provides for the control of the automatic chemical and chlorine feed devices. The Parshall flume was selected because of its advantageous hydraulic characteristics giving small losses in head, and its freedom from clogging.

Method of operation

At minimum rates of flow the plant will provide clarification, trickling filter treatment and final sedimentation; pre- and post-chlorination will be employed for odor control and sterilization. With higher rates of flow increased detention periods can be provided by using both primary and secondary clarifiers. Furthermore, the sewage can be passed through a mixing basin before it enters the primary clarifiers and then returned to another mixing basin, where chemicals will be added before the sewage is delivered to the secondary clarifiers.

In order to gain maximum benefits from the use of chemicals, a portion of the chemically-precipitated sludge from the secondary clarifiers will be returned to a tank in the screen room, and from there fed into the raw sewage before it reaches the primary mixing basin and clarifiers.

After leaving the secondary clarifiers, the treatment process will be the same at all rates of flow. At the higher rates of flow, however, the trickling filter will serve more as an aeration tank for building up the dissolved oxygen content of the effluent than as an oxidizing device. In order to insure proper operation of the trickling filter at both the minimum and maximum rates of flow a special low-head rotary distributor is employed which has double channel distributing arms; one of these accommodates the low flows and the other channel handles the overflow.

A 5-ft. depth of stone is used in the trickling filter bed. This shallow depth was selected for two reasons: First, because the foundation conditions were poor and it was desired to keep the structure above sea level; and second, because of the greater freedom for the passage of air through the shallow bed with consequently more efficient oxidation. The bed rests on an open type underdrain system supported on a concrete floor, with the underdrain system suitably vented to provide a circulation of air under and through the stone bed. The stone is enclosed by a circular concrete wall so that the filter may be flooded when necessary for the control of psychoda flies.

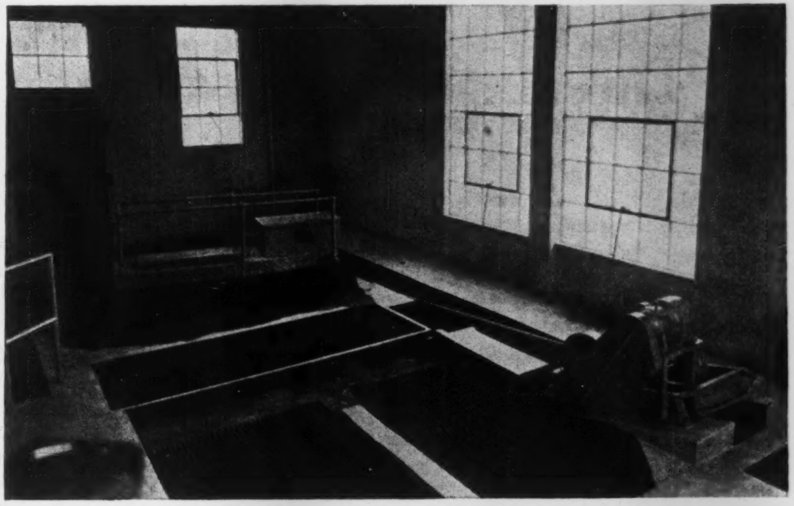


Fig. 4. Hand-raked bar screens and the detritor chamber provided with grit removing equipment, all of which are housed in the control building.

The trickling filter effluent receives a dose of chlorine and is given a 2-hr. contact and settling period in the final clarifier before it is discharged.

Sludge digestion facilities

Sludge from all of the clarifiers (and from the mixing basin, when desired) will be delivered to the primary digestion tank, and when this becomes filled the supernatant liquor will be returned to the raw sewage and the partly digested sludge will be drawn into a secondary digestion tank. The latter will also serve as a thickener to produce a dense sludge with low moisture content.

The use of two digesters provides flexibility of operation as well as extra storage capacity to accommodate the larger quantity of sludge collected during the summer months. Both digesters are fitted with gas collectors, the cover of the secondary tank being of the expanding type. Only the primary digester, however, is provided with heating coils and stirring equipment. The thickened and digested sludge will be drawn on glass inclosed sand drying beds. The filtrate from the beds will be returned to the plant influent.

Sludge gas will be used for providing hot water to heat the primary digester and the control building. Arrangements are made in the control house for the installation of a gas engine generator unit when conditions warrant.

Chlorine will be added to the raw sewage for controlling odors about the plant, and it will also be used to sterilize the final effluent. Chemical feeding equipment is provided for adding lime and alum or copperas to the mixing chambers ahead of the flash mixer. Suitable provisions have been made so that a lime slurry can be delivered to the digester by the sludge pumps.

Wiley and Wilson, consulting engineers, Richmond, Va., designed and supervised construction of the plant. The cost, financed in part by PWA, was $155,000.

The principal equipment was furnished by the Dorr Co., Inc., of New York, and the construction was carried out by the Tidewater Construction Corp., of Norfolk, under the direction of J. D. Ashe, superintendent. R. B. McNutt, Jr., served as resident engineer for the consultants, and R. A. McCoy, Jr., represented Virginia Beach as city engineer.

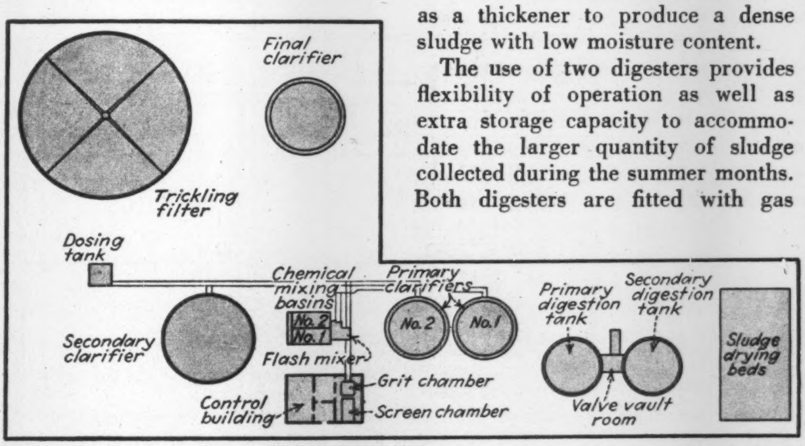


Fig. 3. General layout and principal structures of the Virginia Beach plant.

Direct Design of Continuous Beams

L. E. Grinter

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***Contents in Brief**—Instead of distributing moments, as in the well-known Cross method, this new design method distributes section moduli in a procedure of successive corrections that leads directly to choice of a beam size. It is applicable also to rigid frames. Support settlement is taken into account. No computations are wasted in trial-and-error work, and all computations for a continuous beam can be put on a single sheet of paper.*

The directness of the ordinary design procedure for a simply supported beam under fixed loading has never been approached in the design of continuous beams. Nor was there any hope for a direct method of design of continuous beams as long as the only available tools of analysis were the classical methods that depend upon the solution of simultaneous equations. Hence the designer fell back upon crude assumptions as to the locations of imaginary pins in order to avoid the tedious process of repeated analysis and design. Even with the advent of modern methods of analysis based upon successive corrections the old design procedure has remained unchanged. This has been, first, to guess at the proper beam sections for all spans; second, to balance or distribute moments; third, to redesign overstressed and understressed spans; and then to repeat alternately the analysis and design procedures until a structure is obtained that is neither overstressed nor greatly understressed in any span. This represents the best practice that has been available for obtaining an adequate and economical design.

Direct design

A direct method of design (or perhaps "automatic method" is a better description), presented here, welds these unorganized steps into a routine procedure of successive corrections, not unlike the Cross method of moment distribution that will save a major part of the work involved in making design computations. The method was developed by the writer for continuous beams by 1933. Its application to continuous frames, which will not be discussed in this article, was completed by 1934. Since then the method has been refined but not changed basically. It has also been adapted for the design of members subjected to direct stress and flexure, and for designing for conditions where there is a variation of working stress for different loadings. To avoid confusion, however, this article is confined to the most elementary features of the automatic design of continuous beams. Furthermore, the example given concerns only steel construction whereas the method is equally applicable to reinforced concrete; and only fixed loads are considered, although the method has perhaps its most important usefulness where live loads are involved.

The basis of the method is that for certain special conditions, we may balance section moduli just as moments are balanced because

$$\textit{Section modulus} = \frac{\textit{Bending moment}}{\textit{Working stress}}$$

The conditions under which section moduli may replace moments for balancing are: (a) the working stress must be constant for all members; and (b) the supports must not settle. And even these limitations can be removed later.

The same terminology can be used as for balancing moments with the following revisions or additions:

b, *c*, *d*—breadth, extreme fiber distance, and depth of beam
I/c or *S*—section modulus
I/L or *K*—stiffness factor
L/d—prismatic ratio for a beam of constant depth
F.E.M., *B.M.*, *C.O.M.*, and *C.M.* are abbreviations for fixed-end modulus, balancing modulus, carry-over modulus, and correction modulus.

The sign convention for balancing moduli is the very simple one that a positive-end moment tends to rotate the adjacent joint clockwise. By this choice of signs we have two convenient relationships: (a) the balancing moduli are of the same sign as the unbalanced joint modulus; and

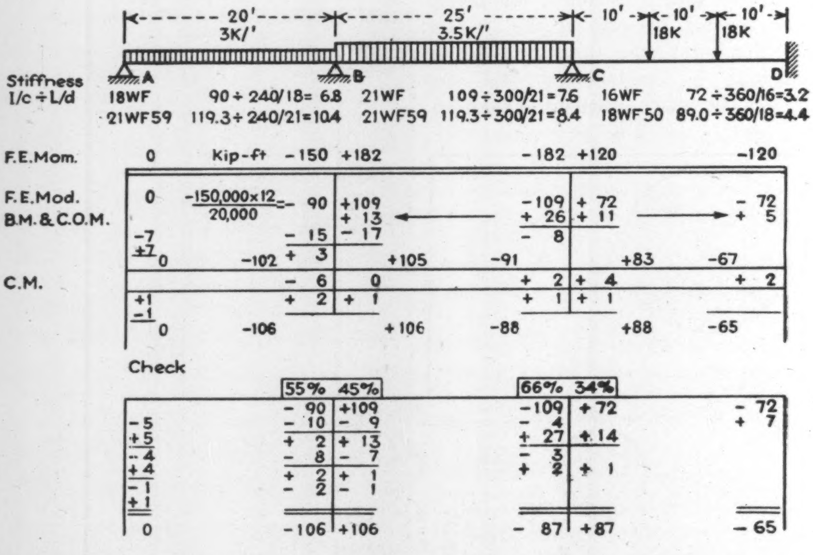


Fig. 1. **Design of a three-span continuous beam by the method of balancing section moduli.**

(b) the carry-over factor is $+\frac{1}{2}$ for a prismatic beam. Of course, the balanced moduli at a joint in equilibrium total zero which means that the final moduli on the two sides of a joint of a continuous beam will be identical in value but of opposite signs.

Instructions for computations

Fixed-end moments are computed for each loaded span, and the fixed-end moduli (I/c) are obtained from the corresponding moments by dividing by the constant working stress. Depths, or the corresponding prismatic ratios (L/d), are guessed at (or otherwise chosen) for each span of the continuous beam. Stiffness factors are then determined from the relationship

$$I/L \text{ (relative)} = \frac{I}{c} \div \frac{L}{d} = 2K$$

by use of the larger fixed-end modulus for each span. Summations ($2\Sigma K$) are needed for each joint.

After these preliminary calculations of *F.E.M.*, L/d, and I/L have been made for each span, we start the balancing process, which may be expressed as *four repeating steps.*

(1) Balance and carry-over section moduli once or twice for each joint. Use $K/\Sigma K$ (or $2K/2\Sigma K$) as distribution factors.

(2) Sum columns of section moduli and use the largest summation for each span to choose a new depth of section (from a handbook when steel is used) which produces a revised L/d ratio.

(3) Recompute I/L (relative) for each span as $I/c \div L/d$, using all new values. (A single slide-rule division is required for each span.)

(4) Deduct each fixed-end modulus from the corresponding column summation of step 2 and multiply each net sum by the corresponding percentage change in I/L. Introduce each result as a *correction modulus* in its proper column. An increase of stiffness (I/L) increases all moments and therefore moduli that are controlled by joint rotation. Fixed-end moduli are first deducted because they are not affected by change of stiffness.

Repeat steps (1), (2), (3) and (4) once or twice to obtain convergence.

Typical design problem

The example (Fig. 1) illustrates the direct or automatic design procedure for a 3-span continuous steel beam acting under fixed loads. The first step is to compute fixed-end moments which are $\omega L^2/12$ for the spans with uniform loading and $2PL/9$ for the span with a load P at each third point. These fixed-end moments which are $wL^2/12$ for the working stress of 20,000 lb. per sq. in. to obtain fixed-end moduli. The first stiffness factors are computed as $I/c \div L/d$ for depths chosen to resist the fixed-end moduli. For example, in the 240-in. span *AB*, a fixed-end modulus of 90 can be provided by an 18-in. *WF* section. Hence

$$2K = \frac{I}{c} \div \frac{L}{d} = 90 \div \frac{240}{18} = 6.8.$$

Balancing of moduli follows the same procedure as moment distribution. The first joint to be balanced is *C*. The values of —109 at the left and +72 at the right provide an unbalanced joint modulus of —37. The balancing moduli are +26 and +11 which are in proportion to the stiffness factors 7.6 and 3.2. Their signs are opposite to the sign of the unbalanced joint modulus —37 so that they will just balance it. The balancing moduli +26 and +11 immediately give rise to carry-over moduli of +13 and +5 at joints *B* and *D* respectively. A carry-over modulus is of the same sign and of one-half the value of the balancing modulus that produces it. Joint *D* is not balanced since it is actually a fixed end.

The balance at joint *B* is for an unbalanced joint modulus of $(109 + 13) - 90 = +32$. Division of the unbalanced modulus according to the stiffness factors gives balancing moduli of —15 and —17 which carry over to joints *A* and *C* as —7 and —8 respectively. The value of —7 at *A* must be balanced by the introduction of a modulus of +7 since this end is free to rotate and the column summation must be zero. There is a carry-over modulus of +3 to *B*.

Correction moduli

Since each joint in Fig. 1 has now been balanced once and since there are no joints that are radically unbalanced, we may stop the balancing process and introduce correction moduli. Column summations give a maximum modulus requirement of 102 in the span *AB*, 105 in the span *BC* and 83 in the span *CD*. Actual sections are chosen to provide these moduli, and new stiffness factors are computed for each span.

The change of stiffness *K* changes moments and therefore moduli in direct proportion to the change in *K*. The moduli thus affected are balancing moduli and carry-over moduli but not fixed-end moduli which are dependent not on stiffness but on loads. Hence at the end *B* of the member *AB* the modulus affected is the difference between the total of —102 and the fixed-end modulus of —90, a value of —12. The stiffness has been changed from 6.8 to 10.4, an increase of 53 per cent. The same percentage increase of —12 is —6, which is the correction modulus recorded. The stiffness of *BC* is increased 11 per cent. The correction at the left-hand end of the span *BC* is negligibly small and is recorded as zero. At the right-hand end of *BC* the correction modulus is 11 per cent of +18 or +2. The correction moduli of +4 and +2 in the span *CD* are caused by a 38 per cent increase in stiffness for this span. If the stiffness of this span had decreased, these signs would be reversed.

After the introduction of correction moduli, the joints are again balanced and any unbalanced moduli left over from previous balances must be included along with the correction moduli just introduced. After the joints *C*, *B* and *A* have been balanced in succession, it is found that there is no unbalanced joint remaining. Columns are summed and the modulus provided by the section in each span, which is recorded above the table, is found to be numerically slightly greater than the corresponding maximum end modulus obtained by the balancing process. Hence a solution has been reached.

If, instead, any section needed to be strengthened or lightened in weight, we would again add or subtract correction moduli for that span based upon the change of stiffness and rebalance. The process may become longer than is shown in Fig. 1 but it cannot become any more complicated. The advantages of the automatic design process over the usual design methods becomes greater as the difficulty of the design problem increases.

A design may be checked from a single analysis by balancing moments or moduli. Fixed-end moduli can be balanced by use of distribution factors obtained from the final sections. The column summations must check the final column summations of the automatic design process. The check analysis is not necessary but it assures that there are no errors in balancing. A simple case such as Fig. 1 shows the automatic process to least advantage.

Mid-span moduli

Although they are not particularly common, cases will occur where the modulus requirements may be greater near the mid-span than at the ends of the span. No difficulty is involved since the curve of controlling moduli has the same shape as the moment diagram. A simple-span moment curve, such as Fig. 2, may be drawn with ordinates in percentages so that one parabola, will serve for all uniformly loaded spans. The curve of Fig. 2 is for one-third point loading, and the total ordinate representing modulus requirement at the one-third point could be 108, obtained from the simple-span moment for span *CD* of Fig. 1. The end moduli of 88 and 65 are plotted as 81 and 60 per cent of the simple-span modulus respectively. From the sloping line connecting these end points it is evident that the maximum interior modulus requirement (32 per cent) is still less than the controlling end modulus. Other shapes of modulus diagrams may be superimposed on Fig. 2 and used repeatedly. Calculations by mental arithmetic will replace the use of Fig. 2 as the designer gains confidence in the procedure.

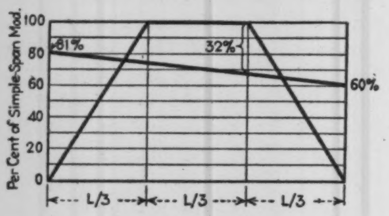


Fig. 2. Use of a simple span moment diagram to determine if modulus requirements along the beam are greater than at the supports.

Economical selection

True economy of material can be easily achieved by the automatic design process. An economy table of section moduli such as the table on p. 90 of the 1937 edition of Steel Construction (A.I.S.C. handbook) is used for choice of sections. Since all sections are listed in their order of economic preference, we will either choose the most economical section for each case or choose an uneconomical section with proper realization of the waste involved.

Web selection for shear

It is understood that beam webs are usually adequate to resist the shear of a continuous beam which is seldom any more serious than for a simple span. If, however, there is some question regarding shear resistance, the procedure would be to compute reactions and shears rather late in the automatic design process (reactions may be computed from moments obtained from section moduli). Then a revision of sections with webs selected for shear resistance would be in order followed by the introduction of correction moduli (to account for change in stiffness) and a final balancing of moduli. Shear could hardly be important except for very short spans or for built-up beams with thin webs.

Taking care of settlement

In unusual cases, particularly with bridges, settlement of supports may be more important than load in its effect upon the design. In Fig. 3, the beam of Fig. 1 is redesigned to allow for the additional effect of a settlement of ½ in. at *C*. Settlement with ends fixed produces an elastic line for each of the spans *BC* and *CD* that is a reversed curve. The fixed-end modulus produced by settlement is

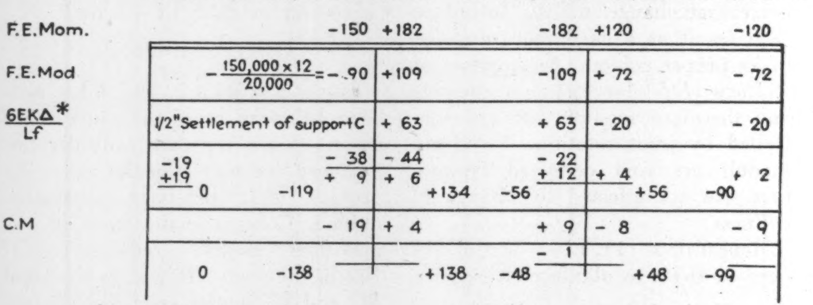
$$F.E.\ Mod. = \frac{6EK\Delta}{Lf}$$

where Δ is the relative settlement of the two ends of a span and f is the allowable working stress. Hence in Fig. 3 we have not only the fixed-end moduli in all spans required by loads but also fixed-end moduli in the spans *BC* and *CD* caused by settlement.

The balancing process is not changed. However, a revision of stiffness does change the fixed-end moduli computed for settlement although it does not affect fixed-end moduli obtained from loads. Accordingly, the first correction modulus of —19 in the span *AB* was obtained as the 65 per cent increase in stiffness (from 7.4 to 12.2) times the total change from the fixed-end modulus due to the loads, or 0.65 (—119 + 90) = —19. Other correction moduli follow in the same manner. The joints would normally have to be rebalanced after the addition of correction moduli but in Fig. 3 the result is practically an automatic balance that completes the design. It is significant that settlement in this instance increased the size of beam section required in each span.

Conclusions

The direct or automatic method of design will be found to be more difficult to understand than to apply. By its use, however, the computations for designing a continuous beam can be placed on a single sheet of paper. Furthermore, the designer soon realizes that he no longer is working in the dark. Every correction represents a step toward the solution of the design problem, and work performed is not discarded when further corrections are found necessary.



* Span **BC**

$$\frac{6EK\Delta}{Lf} = \frac{6\times30{,}000{,}000\times4.2\times0.5}{300\times20{,}000} = 63$$

Span **CD**:

$$\frac{6EK\Delta}{Lf} = \frac{6\times30{,}000{,}000\times1.6\times0.5}{360\times20{,}000} = 20$$

Fig. 3. Design procedure by method of balancing section moduli when pier *C* is assumed to settle ½ in.

Why Unit Price Bids?

***Contents in Brief**—An engineer-contractor with 25 years experience in building and heavy construction reviews the reasons given for unit-price bids and finds them poor. A lump-sum bid is advocated. For obvious reasons, the author remains anonymous.*

THE ONE PRACTICE of engineers which is least understandable to the contractor who is used to bidding on architectural work is that of requiring bids by items and unit prices instead of permitting lump-sum bids with unit prices for work added and work deducted. This practice makes so much extra work for the engineer in preparing plans and specifications, in comparing bids and in computing payments, both current and final, that it must be retained for very good reasons. Those reasons, however, are not easy to see even after years of experience with the system.

Benefits are negative

Let us review the possible reasons. At first it was suspected that engineers might desire unit prices for their own benefit in estimating similar, future work. But prices change so rapidly, vary so much in different localities and under different conditions, that they have little continuing value. Furthermore, the unit prices of the different bidders vary so much, either by reason of careless computation or unbalancing, that they are practically useless for estimating. There are so many other easier and better ways for the engineer to get cost data, that this explanation was rejected.

It was then thought that the method of bidding was adopted to permit bids on a safer basis by inexperienced contractors. However, that supposition could not be reconciled with the clear statements made elsewhere in the specifications that the successful bidder had to have money, experience, equipment and all the other qualifications necessary to make an intelligent lump-sum bid.

It was suggested that the method of giving quantities and bidding by items would produce more intelligent and uniform bids. A careful examination of a long list of bids both on this basis and on a lump-sum basis did not reveal any such result.

The method did seem to afford a fair method of computing the value of changes in the work, but investigation did not sustain that hope. It was a method but not a fair one. Consider a unit price on excavation, for instance. It is only the average price per cubic yard which usually includes a liberal loading for overhead and profit because it is started first. The work involved may consist of clearing, bulk excavation, trench excavation, pumping, sheeting, shoring, fine grading, backfill, storing and spreading topsoil and building embankment. Used as a unit price for changes, it can be equitable only by accident.

If the change involves only steam-shovel excavation, the price may be much too high; if it involves hand excavation in deep trenches or sheeted pits, it may be much too low. On concrete work it is the same story. Additional thickness for a slab on the ground does not cost much per cubic yard; additional concrete in thin walls or slabs with forms and finish is worth much more than the average price. What is an average price good for on miscellaneous metal which includes steel rails, galvanized gratings, highly fabricated items of galvanized wrought iron as well as some copper and brass? What is a unit price on small pipe worth when several sizes are included together with all valves and fittings? It is very evident that neither unit, except by accident, can be fair to both owner and contractor.

Furthermore, the specifications sometimes give the engineer the authority to use unit prices for extra work only at his option. In this case grave inequity may result from requiring the contractor to do extra work at unit prices when those prices are unfair to the contractor and refusing to pay unit prices when they seem unfair to the owner.

It might be argued that unit prices make it easy for the engineers to make proper monthly payments. The answer is that architects and engineers on lump-sum contracts have no difficulty in making such payments. The specifications may be written to require the low bidder to split his total price in such detail as the engineer may desire. The split-up will be just as good as the unit prices in any itemized bid. In both cases they will be made by the contractor with an eye to getting as much as he can on early items; but in case of the itemized bid, once it is accepted, payments must be made in a certain manner. Where a schedule is submitted for a lump-sum bid, it is subject to approval by the engineer and he can see that reasonable amounts are left for later items. If he does permit too much payment for early items, no real harm has been done if the contractor and his bonding company are really selected on the basis of financial responsibility.

Evils are positive

Probably the worst evil of the itemized bid is the temptation to unbalance the prices on certain items to secure an advantage over a competitor. This is not unfair, but it does sometimes enable one contractor to secure a job when he is not the real low bidder on the work as a whole. In other words, it sometimes results in the owner paying more for his job than he should. Such cases arise principally when the engineer makes a mistake in setting up the quantities to be used for a comparison of bids. For example, assume that there are two classes of excavation. The contractor believes that the yardage for one class is too low and will be raised, and that the yardage for the other is too high and will be lowered. So he raises the price on the one, and lowers it on the other. His profit and price on the bid quantities is lowered by this method; but if his calculations are correct, his profit on the completed job will be larger than the profit of his competitor. Furthermore, his original bid would not have been the low one if actual final quantities had been used in the comparison.

This method of bidding permits an unscrupulous engineer to favor a particular contractor over his competitor. He is permitted by the specifications to make changes after the contract is signed—at least up to a certain percent of the total contract price or of the item. And if he has such changes in mind before the letting, it is easy for a contractor who knows of it, to fit his unit prices to take the utmost advantage of the situation.

The specifications often state that bids which are obviously unbalanced may be rejected, but it is very seldom that this is done. It is too hard to prove deliberate unbalancing. Unit bids vary so much on items where the engineer's quantities are demonstrably correct that actual proof of unbalancing is practically impossible to obtain. And without such actual proof, public bodies and engineers both are very loath to suffer the delay and expense of another letting which may even end in the same manner as the first.

Preparation more costly

Unit-price bids cost more to prepare. Bids were put in recently on a sewage treatment plant of moderate size; there were 81 items of which 44 amounted to less than $1,000 each and totalled less than 5 per cent of the entire bid. It probably cost each contractor an extra amount between $50 and $100 to bid the job in this manner. The office work is considerably increased if the bid is compiled carefully and the unit prices computed correctly.

When such a unit-price bid is made up in the main office and transmitted to a representative at some other place, the cost and risk are much more. The writing out of such a bid is an onerous task and full of possibilities for mistakes, even when the engineer does not require three copies of the bid or the separation of each unit into two parts, one for labor and one for material.

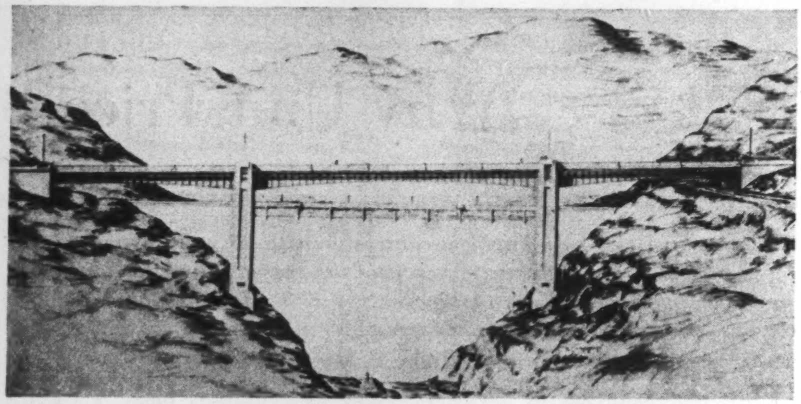


FIG. I. HOW THE TALLULAH FALLS BRIDGE WILL LOOK WHEN COMPLETED.

Georgia Builds 220-Ft. Span Girder

C. N. Crocker

Bridge Engineer, State Highway Board of Georgia, Atlanta, Ga.

New Tallulah Falls bridge is also notable for 90 ft. high cellular piers and unique girder seats

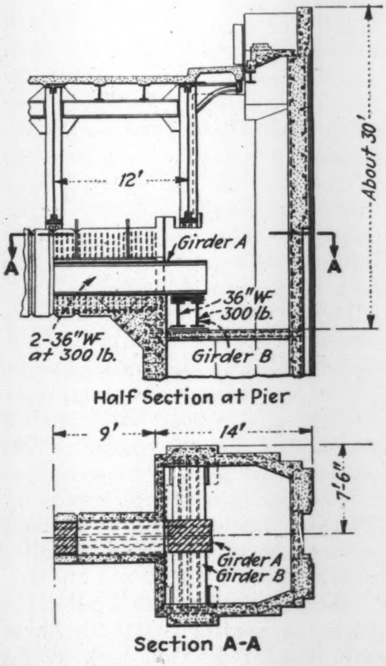
North of Clarkesville, Ga., the Appalachian Scenic Highway (U. S. Route 23), traverses one of the most beautiful scenic mountain regions in the state. Near Tallulah Falls, in Rabun County, the highway crosses the Tallulah River by means of a 12-ft. roadway structure built on a power dam. To eliminate the dangerous congestion caused by this bottleneck, the state highway board of Georgia has begun construction, just downstream from the dam, of a three-span continuous girder bridge with 24-ft. roadway and a center span of 220 ft. This will be one of the longest plate girder spans in the country, and the bridge itself will be notable for its setting over a magnificent gorge with solid rock cliffs rising abruptly on both sides. The total length of the bridge will be 500 ft., made up of the central 220-ft. span and two 140-ft. side spans. The finished roadway will be approximately 25 ft. higher than the present roadway on the dam and 165 ft. above the bottom of the gorge. Outlook bays will be provided at piers and end abutments for the views which may be obtained from this height of both the lake upstream and the rock-lined gorge downstream.

Three plate girders with parabolic bottom flanges will extend continuously throughout the length of the bridge, supporting 18-in. floorbeams on 20 ft. centers, which will carry the 18-in. stringers and a reinforced concrete floor slab. The depth of the main girders varies from 84 in. at the center and ends of the bridge to 150 in. over the piers, the latter being limited by the maximum width of web plate available. Flange angles are 8x6x⅞ in., total cover plate thickness is 2½ in. and maximum thickness of web plate ⅝ in. Horizontal stiffener angles are used over the piers, 4 ft. up from the bottom of the girders.

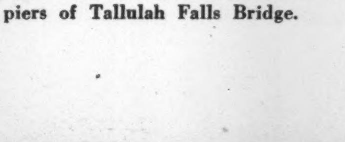
The two main piers are of cellular reinforced concrete construction, each consisting of two 14x16-ft. columns resting on a common 20x50-ft. base and rising some 90 ft. from rock line to top of cap. The main girders rest on pier caps consisting of two wide-flange beams of maximum section, connected by means of cover plates. These beams (*A* in Fig. 2) are transverse to the centerline, are encased in concrete and supported at each end by assemblies of two unencased wide-flange beams parallel to the centerline, which in turn are supported on vertical reinforced concrete columns located at the inside corners of the hollow piers and poured integral with the pier walls. This system brings the reactions to a steel-on-steel bearing, carefully adjusted for deflection, which reactions are then in turn divided to steel-on-concrete bearings. The construction procedure specifies that the superstructure shall be complete and the full dead load applied to the structural steel pier caps before any encasing concrete shall be poured. The hollow pier columns are well braced with structural steel struts at height intervals of about 12 ft.

Careful studies were made in the design of the piers to permit reuse of forms. Inside sections were kept uniform while the architectural effects were obtained by means of offsets in the outside faces.

Bids for construction were received based on two contracts. Contract 1, including all the concrete, was awarded to John Monaghan, Inc., Pelham, Ga., on a low bid of $93,770. Contract 2, including furnishing and erecting all of the structural steel, was awarded to the Virginia Bridge Co., Roanoke, Va., on a low bid of $87,950. Thus the total bid price was $360 per lineal foot of bridge. The specified time of completion is 250 working days for contract 1 and 90 working days for contract 2. On the first of March, Contract 1 was about 50 per cent complete and steel erection was scheduled to begin by June 1.



Half Section at Pier



Section A-A

Fig. 2. Details of girder seats in hollow piers of Tallulah Falls Bridge.

This is a regular federal aid project financed with 50 per cent federal and 50 per cent state funds. All the design work was performed by the personnel of the bridge department of the state highway board of Georgia, and the engineering supervision of construction is being handled by the engineers of the state highway board.

Contractor on River Work Freed of Damage Claim

Missouri Supreme Court holds contractor working under U. S. Engineers not responsible for damage caused by river regulating works

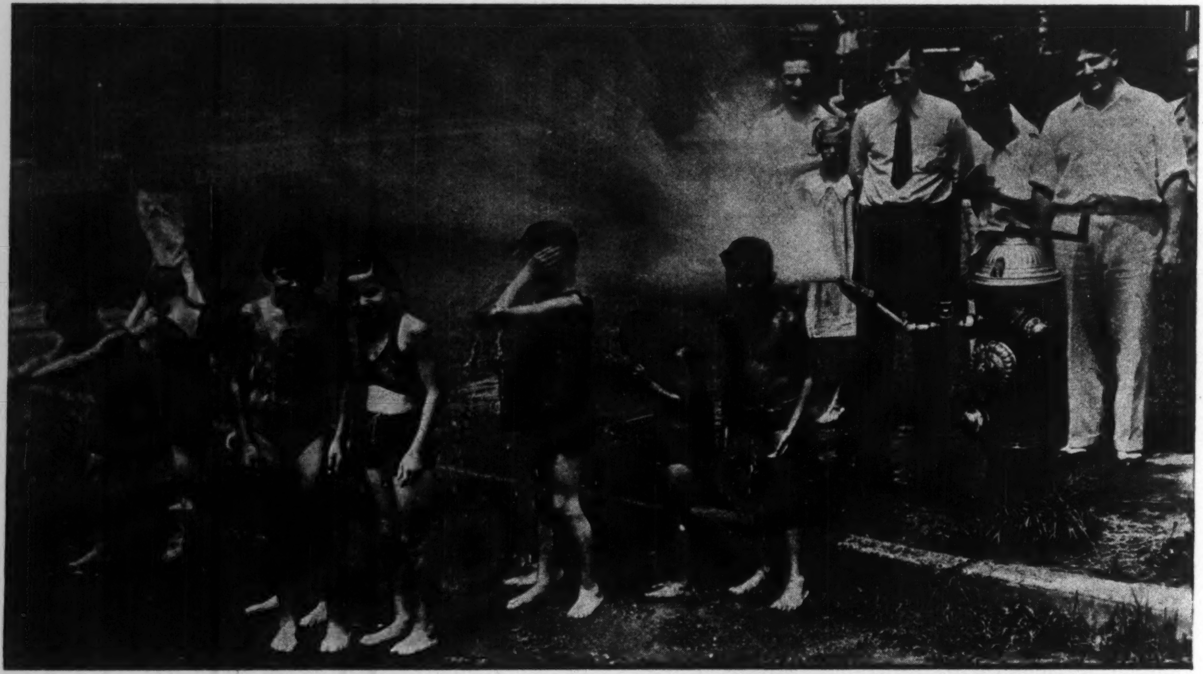
CONTRACTORS building river regulating works under the supervision of the Corps of Engineers, U. S. Army, are not responsible for flood damage resulting from those works, according to a finding of the supreme court of Missouri in the case of Thomas W. Evans *vs.* Construction Co. (No. 35,986), briefly noted in *Engineering News-Record,* Dec. 1, p. 689.

The defendant company was contractor on the construction of dikes and bank protection works being built by the government to improve the navigability of the Missouri River. In June, 1932, high water in the river breached a levee above the point of work and subsequently a large number of farmers joined in a suit brought by Thomas W. Evans against the company for damages totaling $150,000, claiming that the contractor had projected a certain "long dike" to a point 200 ft. nearer to the north bank of the river than was permitted by the U. S. Engineers, also that without authority from the engineers the contractor had installed a "screen mattress" along one-third of the dike in question. These works, it was claimed, so restricted the channel as to raise the water above the dike causing it to overtop the levee and flood lands of the plaintiffs.

The contractor not only denied that he had projected the long dike to a point nearer than 200 ft. from the north bank, but also asserted that all his work was done under the immediate supervision and direction of the U. S. Engineers.

In passing upon the question before it, the court said, "There is no evidence at all in this case that the defendant extended the dike in question beyond the point designated by the U. S. Engineers and government inspectors. . . . There is no evidence at all tending to prove that the defendant was in any way negligent in the actual construction or installation of the screened mat. Therefore, whatever effect the length of the dike or the screen mat had on the water of the river at this dike or above or below it was not chargeable to the defendant, but was a matter for which the government alone is answerable. . . ."

The court also said, "It is admitted that the purpose of dikes is to change the current of the river and to deepen the channel and that dikes will retard the flow of the water. That is just what was being done here, and there were about 25 dikes within the vicinity of the levee breaks, and Dike 314.1 (the long dike) and all of said dikes had been constructed to accomplish this purpose. This program of the government in this vicinity necessarily caused a choking of the river in this sector and when the June rise came the water went through this old levee and inflicted damage on the plaintiff and on other people. Any error or mistake made by the government in the plans or in the direction of the work to be done by the defendant thereunder cannot afford a basis for plaintiffs recovery from the defendant."



FREE PLAY SHOWERS ARE ONE OF THE GOOD WILL SERVICES GIVEN BY THE COMPANY

Selling Good Will with Good Water

J. O. Herr

Manager, Monmouth Consolidated Water Co., Long Branch, N. J.

***Contents in Brief**—This is a case history of a public relations program thoughtfully planned and conscientiously applied by a private water utility serving 21 communities on the New Jersey coast. Of particular merit is the use of regular monthly "clinics" where employees are brought face to face with actual problems and work out their solution. Other activities deal with the operation of free play showers for children, newspaper adverising, and uniforms for field men. Mr. Herr tells how his company strives to sell more than good water.*

TODAY the importance of maintaining sound public relations for any business enterprise, and especially for a public utility company, is so obvious there is little need of discussing the necessity for an effective public relations program. As the company with which the writer has been associated for a number of years has been following a systematic public relations plans—one which was partially developed by our own organization and strengthened by the guidance of our parent company, the American Water Works and Electric Co.—certain of these policies which we have adopted may be of interest and profit to others.

In order that a public relations program be effective, there are certain essentials which must be observed. Therefore before discussing the program itself, I would stress these points: First, the program should be carefully planned; second, it should be continuous rather than intermittent in its application; and third, a spirit of cooperation, good will and friendliness toward the customer must necessarily actuate the behavior of each employee, together with a belief on the latter's part that there is a need for the program.

Using the experiences of the Monmouth Co. as a case history, it can be said that much value has been derived from a system of regular monthly meetings attended by our employees. General problems are discussed and specific improvements are offered for use in solving them. Topics are usually suggested by the employees who wish to be better informed when called upon to discuss such questions with customers.

During the past year the American Water Works and Electric Co. produced a sound slide film for the use of its operating water companies. Entitled "Your Boss and Mine," it realistically portrays many of the common, unthinking errors made in employee contacts with customers. The film then continues by showing a more pleasing way of handling such cases.

The principles of good public relations stressed in this film apply to any type of business, namely: A cheerful smile, a pleasing appearance, a friendly attitude, and a general interest in the customer's problem.

Customer relations clinic

An outgrowth from the film was the establishment of a customer relations clinic. This is a training school for fostering the principles already mentioned. The clinic meets monthly, and for thirty minutes a group composed of the office force, meter readers, inspectors and others having frequent contact with the public discuss questions relating to customer contacts.

The questions and answers used have been prepared previously and approved, in much the same manner as a radio script. Discussions are made as realistic as possible by having one employee enact the part of the customer and another represent a member of the company. The scenes supposedly take place at the customer's residence, on the street, or in the company's office, depending on the nature of the problem.

Prior to each clinic copies of the script showing only the customer's part are distributed for study to every employee. At the meeting two or more employees are called upon to give their versions of how a particular question should be handled. At the conclusion of the clinic a reading of the approved methods of dealing with the situation takes place and everyone present then enters into an open discussion. These discussions are most beneficial and in some instances they have exposed weaknesses in the approved script.

Here are a few examples of the type of questions used in the clinic:

"Why do I have to pay a service or minimum charge to your company and not to the butcher and baker?"

"Why is this bill so high? I did not use so much water."

"The water at my house is discolored. What can you do about it?"

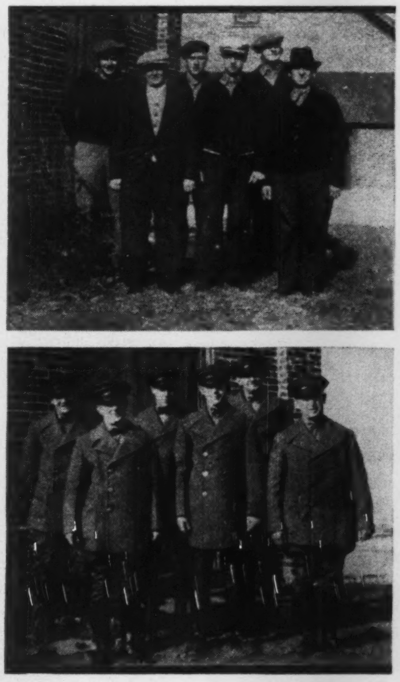
For a happier public

At every meeting special attention is given to strengthening courtesy, tact and demeanor qualities. Occasionally instruction is provided from outside sources. For instance, in order that employees might learn the proper use of the telephone, a representative of the telephone company was invited to give a lecture and demonstration on the subject.

Turning to other phases of our public relations program, we keep in mind that the people of the communities we serve—the same as those of all municipalities—may like to visit the waterworks. We welcome this interest. In fact, we go even further and invite them to come and see the processes used to insure them the best possible drinking water. Naturally it is to the company's advantage to keep its grounds as attractive as possible—and we like to think of our plant as a show place of the community. Furthermore, the company maintains a shack and picnic grounds at the reservoir for the use of any responsible groups so desiring.

One of a series of articles devoted to the proposition that upon the development of better public and employee relations rests the future welfare of the construction industry.

We think it also is a good idea for the company personnel to take part in the civic and social life of the communities we serve. You will probably agree, all companies are judged to some extent by the extracurricular activities of their staff employees.



Do clothes make the man? Maybe not, but here is what uniforms did for the meter reader staff of the Monmouth (N.J.) Consolidated Water Co.

Everybody appreciates unsolicited things done for his convenience and enjoyment. With that thought in mind two summers ago we began a "Play Shower" project to give the children in our territory an opportunity to keep cool and play during the hot days.

Although the twenty-one communities served by our company are located at the seashore, facts show that the showers have proved popular with the residents, adults as well as children having taken advantage of the cooling sprays. Where no outdoor bathing facilities are available and where traffic is light, the shower apparatus is attached to fire hydrants. Suitable barriers are erected for the protection of the children. We furnish the equipment and donate the water and, wherever needed, supply the men to supervise and guard the children at play.

News and advertising

Whenever the company plans new construction or improvements the newspapers are always notified. Townspeople in reading of such activity have more reason to believe that they are being served by an up-to-date plant. And the newspapers appreciate this consideration because it helps them in reporting local news of an interesting nature.

Then there is the matter of advertising. We have found that townspeople are interested in the type of advertisement showing the importance of water in their lives, the various helpful results obtained from certain types of baths, and the proper method of watering the yard for best results.

In case of service failure, whether our fault or not, we have learned that our customers appreciate a quick, full and frank letter of description as to the reason for the difficulty. Their sympathetic response is well worth the trouble it takes to inform them.

Pride in our staff

Another feature of our present public relations program which has been greatly appreciated by both customer and employee, has been the adoption of a snappy, serviceable uniform for meter readers, inspectors and other employees whose jobs take them into private homes. Aside from the pleasing appearance these forest green uniforms afford, the housewives are assured that the wearer is an authentic representative of the company.

When equipped in his smart looking outfit, the employee is more apt to see that his personal appearance is neater. He seems to realize, too, that he is an important representative of the company, and perhaps the only member who enters the homes of customers on business.

Besides the foregoing methods of establishing friendly public relations, we try in every possible way to make each customer, large or small, feel that we sincerely appreciate his patronage, and emphatically are not a hard-hearted monopoly, as occasionally has been believed of utility companies in years past. By faithful practice of this program, we anticipate fostering an even more favorable reputation.

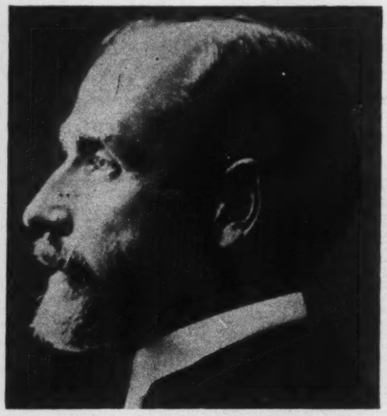
Fifty Years of Water Resources Study

John C. Hoyt
U. S. Geological Survey, Washington, D. C.

Systematic measurement of the flow of streams by the federal government, was inaugurated late in 1888 by the establishment of an instruction camp on the Rio Grande at Embudo, N. M., to develop methods, instruments and equipment necessary to secure information required in carrying out the provisions of an item of $100,000 for surveys relating to irrigation in the Sundry Civil Bill which passed Oct. 2, 1888. The first measurement of discharge, the results of which are published in U. S. Interior Department reports, was made at Embudo, Dec. 21, 1888, by J. B. Williams. This date can be taken as the beginning of the systematic collection of data relative to the water resources of the country. And by the spring of 1889, just 50 years ago, methods of procedure for conducting the investigations had been sufficiently established so that the camp was disbanded and eleven of the men assigned to various drainage basins.

The concept of systematic water studies originated with Major J. W. Powell, the second director of the U. S. Geological Survey, who, with the aid of Capt. C. E. Dutton, outlined the general plan of procedure for starting the work. Frederick H. Newell was then selected to develop the idea and work out the details. He, who was later to become the first director of the U. S. Bureau of Reclamation, was the leading force in the work and more than anyone else was responsible for its success.

For the seven years following Embudo, water resources studies were limited to the arid West in connection with irrigation possibilities. The work really got under way on a nationwide basis in 1895 when an appropriation of $12,500 was made for "gaging streams and determining the water supply of the United States and for the preparation of reports upon the best methods of utilizing the water resources." This broad language covers about every conceivable useful investigation of water supplies, and has been repeated without substantial change in subsequent years. Through the foresight of those conducting the investigations, records of flow are now available at over 7,200 river measurement stations, 3,800 of which are now actively operating, on the more important streams in the United States and on many streams in Alaska and Hawaii. This information is published by the U. S. Department of the Interior in Geological Survey "Water Supply Papers," of which about 850 have been issued.

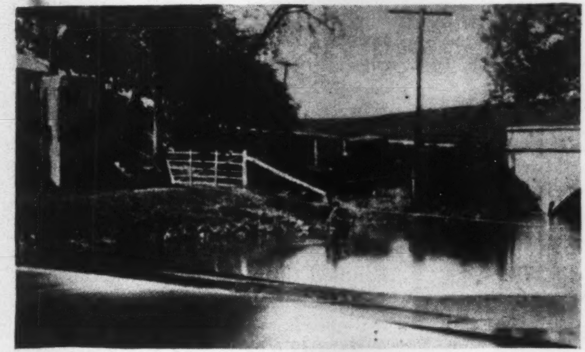


The late Frederick H. Newell, father of the U. S. water resources studies.

Prior to 1900, the maximum annual appropriation was $50,000. In 1903, it rose to $200,000, dropped to $100,000 in 1908, and ranged between $100,000 and $175,000 for the next 20 years. However, the demands for basic information by water users and water planners have caused the annual appropriation to be gradually increased since 1928, and for the fiscal year 1939 it is $1,050,000. This amount is augmented to over $3,000,000 by state and municipal cooperation, by emergency funds and transfers from other federal bureaus.

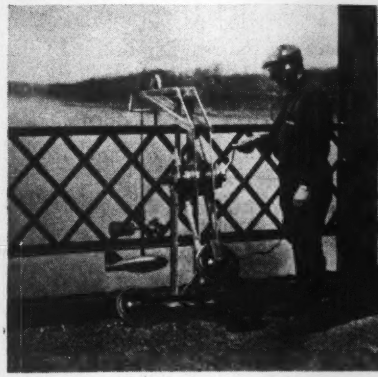
Incidental to carrying on the investigations, methods, instruments and equipment for conducting the work have been improved and developed. The engineers of the U. S. Geological Survey have taken the lead in this development, and the results of their work are accepted as standard not only in this country but throughout the world. As indicated in the accompanying illustration, measurements of the flow of streams are made by wading (1), from a boat (2), from a bridge (3) and (5), or from a car and cable (6). Most velocity determinations are taken with the Price current meter (6) which was developed by W. G. Price in 1882. Although the construction details have been improved, fundamental principles of this instrument are substantially the same as this original model.

Hand and power reels and booms for handling the meter and weights when making measurements have



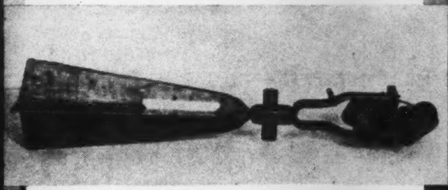
1. Measurement by wading.

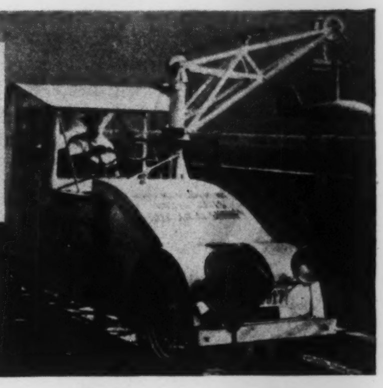
2. Measurement from boat.



3. Hand reel and boom.

4. Current meter (below).

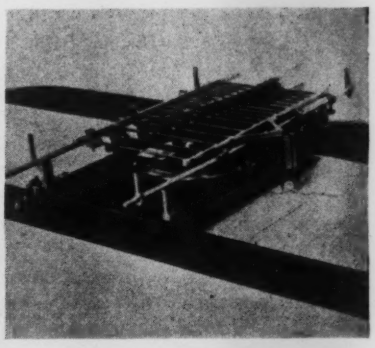




5. Power reel and boom.

6. Cable car (below).

7. Water stage recorder.



8. Discharge integrator.

been developed so that weights as large as 500 pounds can now be used in measuring streams of considerable depth and high velocity. Water-stage recorders (7) have been developed for recording gage heights in place of weight gages, and 70 per cent of the stations now in operation are equipped with such instruments. The discharge integrator for the conversion of gage height graphs into mean daily discharges has been developed (8), and methods for analyzing and interpreting the data have been greatly improved.

Studies are also being conducted of the fundamental problems in regard to the interrelation of surface water and groundwater, and of the effects of climatic conditions, vegetation, topography, geology and the works of man as affecting the occurrence of both surface and groundwaters.

The advances which have been made in the last 50 years in the systematic collection, analysis and use of basic water supply data represent more progress in this line than has been made in all preceding time, and as a result the activity has been established as a major branch of hydraulics.

Notes on Sewage Disposal

A monthly summary of current developments
conducted by Willem Rudolfs

THE BEST TREATMENT — Plant scale research for the purpose of comparing different methods of sewage treatment being difficult to undertake and costly is seldom carried on. Conclusions reached on the basis of results obtained under varying circumstances and with different sewage may in general be correct, but not necessarily applicable to specific conditions. Whedbee and Zeller (Texas Eng. Exp. Sta. *Bull.* No. 45, 1938) operated experimental plants at Dallas where chemical coagulation was compared with a submerged brickbat contact aerator with upward flow and a trickling filter. The average amount of chemical used was about 75 p.p.m. of ferric chloride, while the air consumption for the aerator averaged 3.48 cu.ft. per gallon of sewage. The percentage removal of suspended solids was about the same in each case but the biochemical oxygen demand reduction was lowest using chemical treatment.

	Sus. Solids	B.O.D.
Chemical	89	78.2
Contact aerator	87.5	87.9
Trickling filter	86.9	89.6

The high rate of air application caused breaking of the floc. With stronge sewage chemical treatment costs carried from $26 to $54 per million gallons, in spite of the fact that the coagulant was manufactured at the treatment works from scrap iron and chlorine. It appears that with strong sewage and high purification requirements trickling filters are still far from being outmoded.

SLUDGE SALES — Dried, digested sludge is much in demand at Atlanta, Ga., and the city recently purchased grinding machines for use at two of its disposal plants. The city council has now adopted resolutions setting forth the terms of sale: For ground sludge, $1.50 per cu.yd. where the purchaser loads from the pile; $1.75 when the city loads into the trucks; $2 where the city puts the sludge into sacks, the sacks being furnished by the purchaser. Delivery of ground sludge to the purchaser in bulk or sacks will be made for an additional charge of $2 per cu.yd. where the haul is not greater than 5 miles, and 30¢ per cu.yd. for longer hauls. When the purchaser takes sludge directly from the beds without having it ground, the price is 50¢ per cu.yd. To various departments in the city and in the county, ground sludge is sold at the rate of 70¢ per cu.yd. The department receiving the sludge must do the loading and supply trucking facilities; no charge is made for unground sludge taken directly from the beds.

RADIO SERVICE—What is believed to be the first sewer service truck in the country to be equipped with short wave radio reception facilities has been placed in operation by the Joint Meeting in Essex and Union counties in New Jersey, a sewer authority for eleven municipalities. The installation was made for the purpose of facilitating contact with equipment and service men at the shortest possible time in case of an emergency.

The Joint Meeting operates a trunk sewer some 54 mi. in length and a sewage treatment plant. Maintenance crews and equipment are located at the treatment plant in the city of Elizabeth. From this place to the outermost point in the district is 12 mi. The first-aid equipment carried on a 3-ton motor truck is as follows:

Hydrogen sulfide, carbon monoxide and combustible gas detectors
Wolf safety lamp
Combination velocity blower hose mask with safety harness
Canister type gas masks
Chippers goggles
Portable air blower, 2½ in.
Industrial first-aid kit
Safety belts with ropes attached
1,500 watt portable electric generator and flood-lights

The Joint Meeting uses six employees on general sewer maintenance in addition to the personnel at the plant. The maintenance men have been trained in essential first-aid measures and in addition have had special instruction in the use and operation of the safety devices carried on the truck. At regular intervals drills are held during which the equipment is inspected and tested. The radio set was purchased at a cost of $170, according to E. P. Decker, assistant secretary of the Joint Meeting. Broadcasting of messages is handled through the police radio facilities at Newark without cost.

AERATION RESULTS—There are few places where different types of activated sludge aeration units have been in operation side by side for an extended period of time. For that reason the results obtained from four full scale plants at Manchester, England, are of considerable interest for comparative purposes. The raw sewage averages 236 p.p.m. B.O.D. sewage averages 236 p.p.m., B.O.D. and 237 p.p.m. suspended solids content. (Rivers Dept. *Report*, 1938). The settled sewage contained 173 p.p.m. B.O.D. and 93 p.p.m. suspended solids. Results obtained during 365 days operation are:

	Vol. treated m.g.d.	Detention hrs.	Hp. per m.g.d.	B.O.D. red. %
Bio-aeration	.602	18.3	45.6	90.4
Simple aeration	1.167	13.7	29.3	92.3
Diffused air 1	3.253	10.2	33.8	91.5
Diffused air 2	3.234	10.2	34.0	92.1

FILTER FLIES—It has been claimed that filter fly (*Psychoda*) larvae are drowned when the filters are periodically flooded. This is not the case. The larvae are washed out of the filter when the flooded beds are emptied. It has also been claimed that filter flies will not or can not breed in enclosed filters. Hamlin and Wilson (*Proc.* Inst. Sew. Pur. Part II, p. 43, 1937) found that flies leave the enclosed filter via the bottom vents in huge numbers in the evening and cluster in masses on the walls and on the ground near the filter. When small holes were drilled through the walls of the closed filter, immediately on piercing the walls, clouds of *Psychoda* flew out, showing that they were living in the filter. The numbers of flies were so great on occasion that they were scooped up and wheelbarrows full disposed of. The larvae shun the direct sunlight but appear on the surface after dark. Enclosing filters, therefore, appears to prevent the continuous distribution of adult flies.

What It Takes To Weld a Building

Amounts of metal, labor and electric current required on an 18-story building in Boston

IN A RECENT ADDRESS before the Boston Society of Civil Engineers, J. Theodore Whitney, consulting welding engineer of Boston, presented a breakdown of his figures on the 18-story George White Memorial Building of the Massachusetts General Hospital group in Boston. Because of the necessity for reducing construction noises, the building was specified to be shop riveted and field welded. The building, of tower type, covers about 28,000 sq.ft. on the ground and is 206 ft. high from basement to roof. The total steel required was 2,274 tons.

Welding was done with eight 300-amp. machines, and $\frac{5}{16}$- and $\frac{3}{16}$-in. electrodes were used. An average of five welders and a maximum of eight were required. Welding began Aug. 16, 1938 and was finished Nov. 23, 1938.

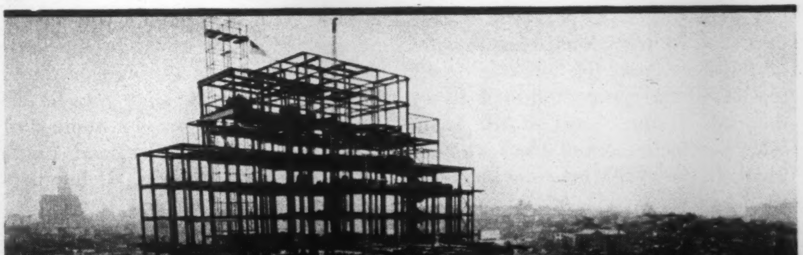
So far as welding procedure was concerned, the welding foreman laid out the lengths and designated the sizes of all welds in accordance with the welding details, and the inspector checked these lengths and sizes as well as the actual condition of welding.

WELDING METAL, TIME AND CURRENT ON AN 18-STORY HOSPITAL BUILDING

Height, basement to roof (18 levels)	206 ft.
Total tonnage in building	2,274 tons
Total length of welding	115,238 in.
Equivalent 5/16-in. welds	129,516 in.
Equivalent 3/8-in. welds	89,925 in.
Welding per ton	50.68 in.
Equivalent 5/16-in. welds per ton	56.95 in.
Equivalent 3/8-in. welds per ton	39.54 in.
Welding done by foreman	3,074 in.
Welding done by welders	112,164 in.
Welders' time	2,060 hr.
Welding per hour of welders' time	54.4 in.
Welding per day welders' time	36.26 ft.
Total helpers' time	580 hr.
Welding per hr. of helpers' time	198.7 in.
Hoisting engineer's time (Union requirements)	842 hr.
Welding per hr. of hoisting engineer's time	136.86 in.
Foreman's time	592 hr.
Welding per hr. of foreman's time	194.7 in.
Electrode bought: 5/32 in.	500 lb.
3/16 in.	4,900 lb.
Total	5,400 lb.
Weld, per lb. of electrode wire bought	21.34 in.
Total electrode melted (Assume waste as 30%)	3,780 lb.
Weld, per lb. of electrode melted	30.49 in.
Electrode melted per ton of steel	1.66 lb.
Total electricity used	13,754 kw.hr.
Electricity used per ton of steel	6.05 kw.hr.
Electricity used per lb. of electrode melted	3.63 kw.hr.
Electrode melted per kw. hr.	0.274 lb.

Welding followed closely behind steel erection. Every joint, as it was reported daily by the inspector, was checked off on the erection plans in both the field and in the welding engineer's office. The accompanying table, compiled by Mr. Whitney from his records, gives the complete story of this job in terms of metal, labor and electric current required.

Coolidge, Shepley, Bulfinch & Abbott, Boston were the architects; New England Structural Co., Everett, Mass., the fabricator and designer of the welded details subject to the approval of the welding engineer; the Scott Welding Co., Brooklyn, N. Y., the welding contractor; and the Sawyer Construction Co., Boston, general contractor. Anthony S. Coombs, a member of the Whitney Engineering Co., served as welding inspector.



Hospital building in Boston which was field welded to reduce construction noise.

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Facilities Expanded For Training Sanitary Engineers

Twenty-five colleges, almost evenly distributed throughout the country, now offer undergraduate courses, some of them leading to special degrees, in the expanding field of sanitary and public health engineering. By comparing the number of colleges giving undergraduate training in this subject today with those listed in a similar survey of 1929, Arthur P. Miller, Sanitary Engineer, U. S. Public Health Service, reports that thirteen new colleges are now in this particular educational field not previously included, and that seven colleges shown in the former report are not now included.

"The net increase in the number of colleges giving training to those wishing to engage in this type of work apparently represents a healthy growth," Mr. Miller said. "It is well known that public health work and the designing and construction of projects essential to improving environmental sanitation have both increased in recent years. The demand for men trained to engage in activities in those two specialized fields has naturally increased and more training centers to provide the needed personnel are required."

It was further stated that civil engineering courses of 45 additional colleges include sanitary engineering subjects requiring up to 10 per cent of the student's time.

FROM FIELD AND OFFICE

Working problems and time-saving methods . . . Edited by Charles S. Hill

Identifying Survey Corners

GEO. F. YOUNG

St. Petersburg, Fla.

Field identification of survey corners is one of the problems frequently met by surveyors. The writer has helped to solve this temporarily by having a yardstick firm stencil his name and address on the sides of the stick instead of the usual graduations. Where there are differences in opinion as to the location of the corners this identifies the corner. In a recent case the adjoining owner removed the pipe not knowing a registered surveyor had set it. These markers lead readily to the stakes or pins which are usually placed low enough to avoid disturbance. It serves as an underwriting of the survey. Incidentally, the marker has an advertising value.

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Marking Traffic Lines

N. F. SCHAFER

Engineer of Maintenance,
Indiana Highway Commission,
Indianapolis, Ind.

The centerline that is a characteristic of Indiana state highways is marked by the maintenance department. A self-driven motor vehicle with very narrow tread (around 30-36 in.) and a long wheelbase (20 ft.) is the most economical method of putting down a centerline. The operator of this marker can keep a straight line and traffic can run unmolested on either side of the line. This work is done when the temperature is below 40 deg. F. and when the pavement is dry. A heavy cutback asphalt is used (R.C. 3 or 4, state highway commission of Indiana standard specifications) on all types of surfaces. On rock asphalt surfaces a finely crushed stone is applied from a hopper on the marker to increase the visibility of the centerline. This is immediately rolled with a portable roller. The cost of this work is about $10 a mile for equipment, material, and labor.

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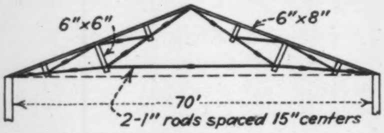
Interesting Truss Construction

K. B. HUMPHREY

Sayreville, N. J.

The sketch shows an iron-rod truss which was erected over thirty years ago and is still in service. No doubt this type of truss was used because of the heat from the brick kiln, the top of which comes within 4 ft. of the rods at the center of the span. Why this same sort of truss was not used on the spans between the kilns is not known. Every alternate truss in this section of the building has the rods. The trusses are spaced 16 ft. apart. The unusual feature of this construction is that the span is 70 ft. Kidder states that for moderate spans such trusses are cheaper than steel trusses, and where the rafters and purlins are of wood (as is the case in this instance) they are about as good. It would seem that a moderate span would be about 50 ft. It is understood that the trusses were built flat and then tipped up in place, the rods being finally adjusted after the roof load was on.



Iron-rod and timber truss.

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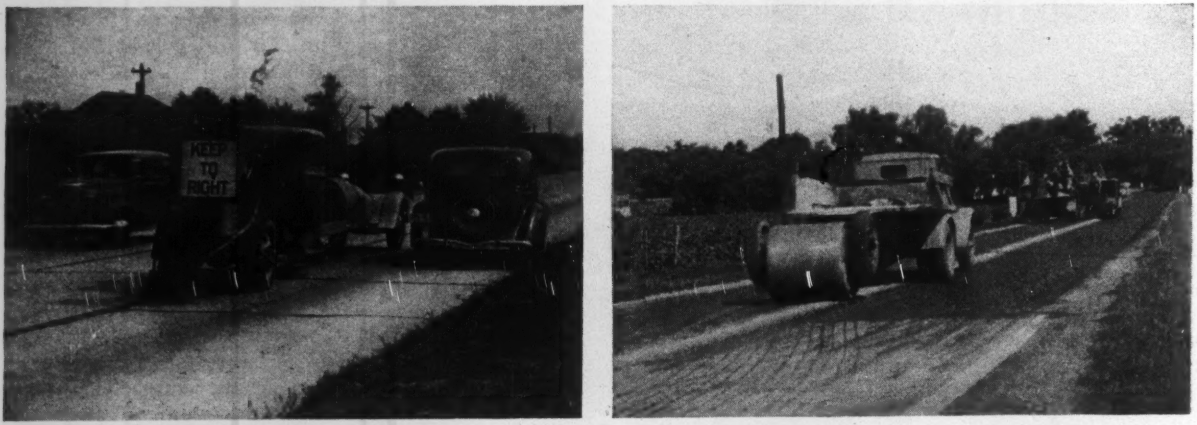
Where the Decimal Point Goes

JOHN B. DOUGLASS

Charleston, W. Va.

The number of computers who have trouble in placing the decimal point in slide-rule computations is astonishing. Perhaps the following rules will help: they were taught the writer by Prof. Carl Cathers, West Virginia University and to the writer's knowledge have never been published before:

When *multiplying* and the slide goes to the right the product will possess the sum of the digits of the multiplicand and the multiplier less one; when the slide goes to the left the product will possess the sum of the digits. If *dividing* and the slide goes to right the quotiant will have a number of digits equal to the dividend digits minus the divisor digits plus one; but if the slide goes to left the quotient will possess a number of digits equal to the dividend digits minus the divisor digits. If numbers



Centerline marker (left) and roller (right) rolling chips into wet mark.

CAMERA NOTES AT THE CORPUS CHRISTI FILTER PLANT

The ball-bearing rotary ventilator (left) is set over the pipe gallery of the Corpus Christi, Tex., filter plant at Calallen to maintain air circulation and prevent the pipes from sweating. Shown in the center are three sets of aluminum aeration bowls Each bowl has orifices in the bottom, the jets from which are protected from the wind by surrounding aspirator chambers, cone-shaped at the top and cylindrical at the bottom. At the right is an ornamental cascade and goldfish pond at which the ingenious superintendent has rigged up an automatic "fish feeder." It consists of an electric light bulb suspended a few inches above the water surface to attract insects to the light and to the reflection of the light. Visitors watch interestedly to see the fish make a strike under the light as a bug hits the water.

less than one are being *multiplied* the ciphers are handled as minus digits; when *dividing* the ciphers are handled as plus digits.

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Sound Control In Blasting

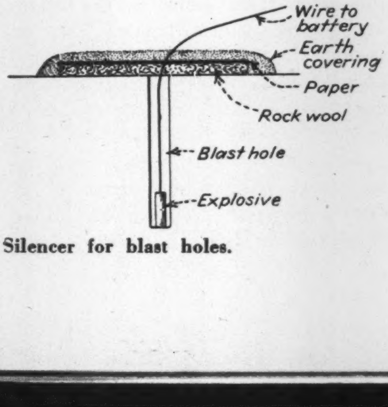
F. R. Cozzens

Stockport, Ohio

It often becomes necessary to do blasting close to schools, hospitals and other institutions where noise is especially objectionable. Noise from such blasting may be controlled to a great extent by the surface insulation illustrated.

The general procedure is to place a covering of rock-wool or loose asbestos fiber over and around each loaded blast hole for a distance of 6 ft. The fiber cover averages 3 in. thick, and over it is spread a layer of heavy-grade building paper. The paper is then covered with an inch or so of loose earth, which is sprinkled with water to hold the insulation firmly to the ground. Connecting wires are pushed up through the covering, and the charge is fired electrically in the usual manner. About 20 lb. of fiber and 25 sq.ft. of paper are required for each hole, and the insulation cost per hole averages 47¢.

The effects are similar to the action of a silencer on a rifle. Sound of the explosion is initially muffled upon contact with the surface insulation, and in scores of tested blasts the noise nuisance was reduced as much as 40 per cent.



Silencer for blast holes.

Field & Office Comment

Revising Highway Curves

Sir: In adding transitions to a simple curve without changing the center of the curve appreciably it is unnecessary to make the calculations shown by W. T. Hughes in *Engineering News-Record* Feb. 16, 1939, p. 74. Values for E_s and T_s are read directly from Table IV of the book "Transition Curves for Highways" prepared by the U. S. Bureau of Public Roads.

In the numerical example presented by Mr. Hughes, I (or Δ in the book) is 60 deg. and E_s of the original curve is 147.80. In the book one turns to Table IV for $\Delta = 60$ deg., page 121, and reads $E_s = 147.7$ for $D = 7$ deg. and $L_s = 600$ ft., or $E_s = 148.9$ for $D_c = 6$ deg. and $L_s = 150$ ft. Either combination is satisfactory for all practical purposes, one being within 0.1 ft. and the other within 1.1 ft. of the original line.

Once the design is chosen all other data for laying out the curve with transitions may be taken from the book without calculations. If the first design in the numerical example is chosen $T_s = 781.76$ is read directly alongside E_s. Turning to Table V for $L_s = 600$ ft., pages 186 and 187, all the data for the transition are read alongside $D_c = 7$ deg. These data include deflection angles from the point of spiral to points on the transition dividing it into 10 equal lengths.

"Transition Curves for Highways" may be procured by sending 60¢ (not in stamps) to the Superintendent of Documents, Washington, D. C. The writer is the author.

Joseph Barnett

Washington, D. C. Feb. 21, 1939

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Bridge Camber On Crests

Sir: In the article on "Bridge Camber On Crests" by C. B. Coe (*ENR*, Jan. 5, p. 40), the formula for camber should be

$$C = \frac{B^2 (g-g')}{800\,L}$$

where C = camber in feet.
B = span of bridge in feet.
$g\text{-}g'$ = algebraic difference in grades in per cent.
L = length of vertical curve in feet.

The omission of the square of B was doubtless a typographical error, which should be corrected in your columns before some unwary engineer uses it.

To the camber thus computed should be added a camber equal to the deflection at mid-span under full dead load to obtain the total camber required for the bridge.

Eric C. Norton

Albany, N. Y. Jan. 23, 1939

From an Editor's Notebook

Travel notes made by editors on their visits to men in the field

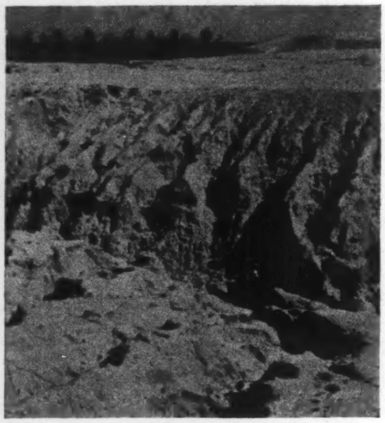
Merely mention the word "canal" in Florida and you start a discussion that is hard to stop. Opinions concerning the desirability of the proposed Gulf-Atlantic ship canal divide the state now as effectively as a waterway will when and if it should be built. Floridians to the north and adjacent to the canal route are in favor of its construction. Those to the south are vehement in their denunciation of the project.

In the northern part of the state the waterway is visualized as a corridor of traffic which will bring untold development to the region. Jacksonville, eastern terminus of the canal, among other things would become the gateway to the gulf. Ocala, a conservative community of 8,000 people located near the midpoint of the canal, with sober jubilation entertains hopes of becoming the major fruit-shipping center of the state. And all along the route tiny hamlets see the proposed waterway as perhaps their only opportunity to grow to greater stature.

But in Miami, Tampa and St. Petersburg, key cities of the southern peninsula, the project is vigorously damned. The strongest reason advanced for its condemnation is the possibility that groundwater supplies will be affected. Construction of the cut and subsequent entry of sea water may ruin the water supply, it is argued, and since no authorities are willing to guarantee that this will not occur, the undertaking should be abandoned. Furthermore, it is pointed out, the canal would give a shipping time advantage to Texas fruit growers, which would be detrimental to the Florida citrus industry.

Tampa is not so concerned about these things, however, as it is about possible loss in shipping; among other port facilities at this place is the largest drydock between Mobile and Norfolk. It is pointed out that if the canal is a "commercial and military need," as President Roosevelt recently stated, why does he suggest a construction period lasting as long as 10 to 15 years?

Seldom heard but nevertheless reported to be actively at work in discouraging the construction of the waterway are the major railroads serving the state—the Seaboard, the Atlantic Coast Line and the Florida East Coast Ry. They have made Florida what it is today. Quite naturally they exert an important influence on affairs in this state.



The work of erosion on a once neatly trimmed bank of the Florida Canal.

Observing part of the cut already made near Ocala—a great ravine whose once neatly trimmed banks and berm have been badly eroded by rain wash—it may be difficult to conceive of great ocean liners steaming through the scrub-pine forest. But as one observer remarked "Any project that has been talked about for more than a hundred years, and which will cost a couple of hundred million dollars to build, has just got to go through some time. And to meet the needs of political expediency we can excavate it during this depression, and fill it up during the next one." —E.J.C.

Florida, Feb. 1939

Looking across the canal cut near Ocala where the bottom width is 250 ft. Since this work was done in 1936 rain wash has eroded the banks.

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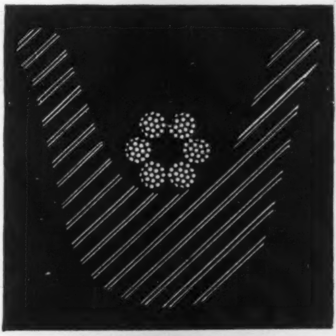
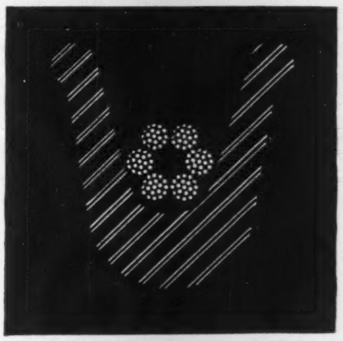
Explosion Hazards in Manholes Studied in Boston

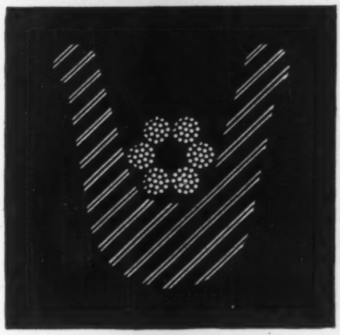
An investigation of combustibles in manholes in Boston, conducted by the U. S. Bureau of Mines, shows a marked reduction in explosion hazards. A general survey of the constituents present in manholes showed two general types of contamination: (1) gases containing hydrogen, carbon monoxide, illuminants, and methane, usually due to manufactured gas that had found its way into manholes from leaks in gas mains and services, and (2) gases that contained abnormally high percentages of carbon dioxide, varying amounts of methane, and low percentages of oxygen, termed "soil" gases.

The results of the survey are given in report 3433, which may be obtained from the Bureau of Mines, Washington, D. C.

PROPER SHEAVE GROOVES INCREASE *rope life*







Insure maximum rope life by using sheaves with the proper groove diameter. Before installing a new rope, sheave and drum grooves should be checked carefully.

●

Figure 1. Sheave grooves that are too large will tend to flatten the rope. This type of groove increases slippage and subsequently abrasion.

●

Figure 2. Sheave grooves that are too small support the rope only on the side walls of flanges resulting in pinching and crushing of the rope. Frequently this condition is aggravated by an old rope wearing a deep groove of small diameter. In such instances the new replacement rope, being slightly larger in diameter, is also damaged by the non-uniform flange walls.

●

Figure 3. Correctly designed sheave grooves give the rope maximum support without pinching, crushing or damage to it.

●

The small cost of dressing down grooves to the proper contour, or when necessary, even the cost of new sheaves will be more than returned in longer rope service.

TRU-LAY Preformed rope best adapts itself to the sheave groove.

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CONTRACT UNIT PRICES

What contractors are bidding on different kinds of construction work

HIGHWAY BRIDGES, WYOMING

OWNER: Wyoming State Highway Commission, Cheyenne; J. R. Phillips, district engineer.

PROJECT: Construction of six treated timber bridges and 33 reinforced concrete culverts on 14 miles of U. S. 20 between Casper and Glenrock in Natrona and Converse counties. Work is to be completed in 180 working days. Transportation facilities by rail and highway are available. For the 33 concrete culverts there is a relatively small amount of Class "A" concrete needed. This is due to the fact that 13 of the culverts are to be built over pull-rod lines used in pumping wells in an oil field, and only small boxes are necessary. The pull-rod boxes are to be built without interfering with the continuous operation of the rod lines.

BIDS: Twelve bids were received Jan. 26, 1939, ranging from the contract low of $74,330 to $87,713. Minimum labor rates are as follows: skilled, 80¢ per hr.; semi-skilled, 65¢ per hr.; common, 55¢ per hr.

LOW BIDDERS:

1. Peter Kiewit Sons Co., Omaha (contract)	$74,330
2. Rognstad-Olsen, Casper	77,753
3. Geo. W. Condon Co., Omaha	78,731

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Excav	8,500 c. y.	$0.25	$0.25	$0.25
2. Overhaul	1,700 c. y. sta.	.015	.015	.015
3. Watering	45 M. gal.	3.50	5.00	4.00
4. Mechanical tamping	1,740 hr.	1.50	1.50	1.00
5. Tr. timber	165,409 M.b.m.	90.00	106.00	103.00
6. Untr. timber	3,780 M.b.m.	90.00	106.00	100.00
7. Tr. timber piling	5,888 l. f.	1.00	1.10	1.00
8. Cl. A. conc	2,031 c. y.	17.00	17.50	19.00
9. Reinf	182,770 lb.	.05	.045	.0475
10. Struct. excav	1,980 c. y.	1.00	1.00	.50
11. Class 1 riprap	1,000 c. y.	2.50	2.50	3.00
12. Pile shoes	28 ea.	5.00	3.50	3.00

STREETS, MINNESOTA

OWNER: City of Duluth; T. F. McGilvray, city engineer.

PROJECT: Concrete paving on 53rd St. west from Ramsey St. to Northern Pacific right of way and from Ramsey to Bristol St.; also 54th St. west from Main to Ramsey St. Project includes 8,700 sq.yd. of pavement and 5,260 lin.ft. of 6-in. integral curb. Stipulated contract time is six months. Transportation facilities by rail, highway and water are available.

BIDS: Three bids were received Feb. 10, 1939, ranging from the contract low of $28,692 to $30,088. Minimum labor rates are as follows: skilled, 70¢ per hr.; semi-skilled, 67½¢ per hr.; common, 62½¢ per hr.

LOW BIDDERS:

1. John Wiinamaki, Duluth (contract)	$28,692
2. Thornton Bros. Co., Duluth	29,093
3. Julien & Broman, Duluth	30,088

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Earth excav	2,600 c. y.	$0.60	$0.60	$0.60
2. Rock excav.	33 c. y.	3.00	3.00	.60
3. Earth excav. in trench	660 c. y.	2.00	2.10	1.70
4. Rock excav. in trench	13 c. y.	5.00	3.00	1.70
5. Approved backfill	100 c. y.	1.00	1.25	1.50
6. Oiled rock	3 c. y.	10.00	9.00	10.00
7. Conc. pav. removed	25 s. y.	2.00	3.00	4.00
8. Conc. walk removed	45 s. y.	.50	.50	.50
9. Conc. crosswalk removed	25 s. y.	1.00	1.00	1.00
10. Conc. pavement removed	8,700 s. y.	2.36	2.48	2.38
11. Conc. walk	455 s. f.	.25	.24	.25
12. Manhole adjustment	16 vert. f.	5.00	3.00	5.00
13. Conc. header removed	166 l. f.	.50	.30	.20
14. Conc. curb removed	90 l. f.	.25	.30	.20
15. Conc. header new	224 l. f.	.40	.40	.50
16. 6 in. integral curb	5,260 l. f.	.30	.35	.27
17. 6 in. integral retaining curb	44 l. f.	1.50	1.10	2.00
18. 10 in. reinf. conc. pipe	452 l. f.	1.10	1.00	1.05
19. 12 in. reinf. conc. pipe	1,200 l. f.	1.30	1.20	1.25
20. 15 in. reinf. conc. pipe	30 l. f.	1.50	1.50	1.35
21. Manholes	6 ea.	90.00	75.00	80.00
22. No. 27 inlets	18 ea.	30.00	26.00	28.00
23. Inlets removed	7 ea.	5.00	8.00	5.00
24. Monument boxes	4 ea.	10.00	7.50	9.00

RESERVOIR, OREGON

OWNER: Water Board of Eugene, Ore.; J. W. McArthur, general superintendent. Stevens & Koon, Portland, engineers.

PROJECT: Construction of a reservoir, unit 2 of a PWA waterworks project, including water level recorder, centrifugal pump with motor, and other appurtenances. Transportation facilities by rail and highway are available.

BIDS: Eight bids were received Feb. 27, 1939, ranging from the contract low of $149,888 to $218,553. Minimum wage rates are as follows: skilled, $1.20 per hr.; semi-skilled, 75¢ per hr.; common, 50¢ per hr.

LOW BIDDERS:

1. H. J. Adler Construction Co., Yakima, Wash. (contract)	$149,888
2. Bennett & Taylor, Los Angeles	164,699
3. Mountain States Construction Co., Eugene	172,855

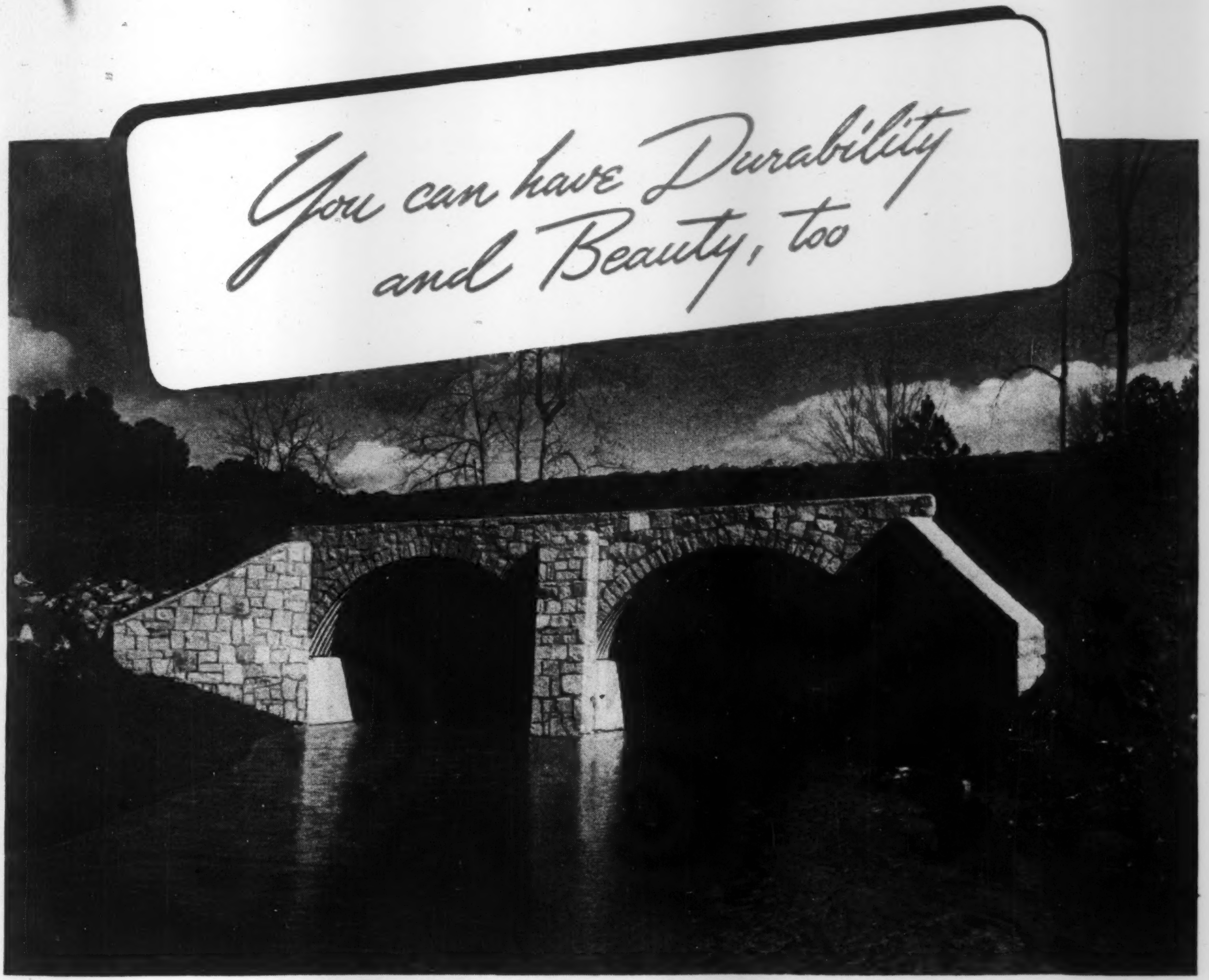
Item	Quan.	Unit Prices (1)	(2)	(3)
1. Common excav., found	300 c. y.	$1.50	$2.00	$0.90
2. Rock excav., found	10 c. y.	3.00	10.00	5.00
3. Cl. A conc	2,820 c. y.	11.50	15.00	12.00
4. Cl. B conc	4,800 c. y.	12.90	14.25	16.00
5. Cl. C. conc	100 c. y.	10.00	10.00	16.00
6. Reinf	870,000 lb.	.0374	.035	.042
7. Exp. joints	12,300 l. f.	.55	.60	.55
8. 8-in. sewer pipe and fittings	1,000 l. f.	.25	.60	.45
9. Gravel	400 c. y.	1.50	1.75	1.50
10. Conc. posts	200 ea.	4.00	5.00	6.00
11. 1½-in. pipe, fitting for railings	4,400 l. f.	.20	.32	.35
12. 4-in. wash water line	500 l. f.	1.00	1.15	1.15
13. Control piping & fittings	L.S.	200.00	70.00	125.00
14. Metal roof and screens	L.S.	1,200.00	440.00	1,300.00
15. Misc. metal work	L.S.	450.00	420.00	600.00
16. 16-ga. galv. water stops	L.S.	500.00	320.00	450.00
17. Recorder and indicator	L.S.	500.00	420.00	500.00
18. 16-in. control valve	L.S.	300.00	915.00	1,000.00
19. Centrifugal pump	L.S.	400.00	385.00	400.00
20. Backfill around reservoir	L.S.	600.00	2,230.00	850.00
21. Rock facing around reservoir	430 s. y.	1.25	2.20	1.00
22. Rock facing graded slopes	270 s. y.	1.25	2.00	1.00
23. Common excav.—grading	22,000 c. y.	.30	.15	.30
24. Rock excav.—grading	100 c. y.	1.00	2.00	1.00

MISSISSIPPI RIVER BRIDGE, ILLINOIS AND IOWA

OWNER: City of Rock Island, Ill.; Ash, Howard, Needles & Tammen, Kansas City, Mo., engineers.

PROJECT: Construction of a highway bridge over the Mississippi River between Rock Island, Ill., and Davenport, Iowa. Of tied girder steel arch construction, it is to consist of two 540-ft. and three 396-ft. spans carrying two 20-ft. lanes with center strip, and two sidewalks. Total length including approaches is to be 4,447 ft. Transportation by rail and highway is available.

(Contract unit prices continued on page 68)



New Toncan Twin Span Arch Bridge on state highway in Fulton County, Ga.

. . . IN A TONCAN SECTIONAL PLATE ARCH BRIDGE

WHEN a drainage structure is required to compliment existing highway or parkway improvements, nothing rivals the beauty obtainable in a Toncan sectional plate arch bridge. With headwalls constructed of natural material usually available in the locality, the effect is one of unusual harmony and rustic beauty.

There are many advantages in using Toncan sectional plate for small bridges, outstanding features being simplicity of design and construction. The plates, which are especially fabricated to order, may be transported with ease to the bridge site. The metal structure may be erected in a few hours' time by unskilled labor. Once installed, rust-resistant Toncan Iron, in any form of drainage structure, will give lasting, trouble-free service.

Ask your Toncan representative to see designs and cost data on some of the new Toncan drainage structures recently built for Federal, State and local authorities. Toncan Culvert Manufacturers' Association, Republic Building, Cleveland, Ohio.

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"EMBLEM OF QUALITY AND SERVICE"

TONCAN IRON — A PRODUCT OF REPUBLIC STEEL CORP'N

(Contract Unit Prices continued from page 66)

BIDS: Bids were taken Feb. 17, 1939, on contracts 2, 3, 4, 5, 6, 7 and 8. Contracts 4 and 7 cover the entire job, and awards were made on this basis. Contract 1 for miscellaneous bents was awarded previously. On contract 4 (substructure) there were five bids ranging from the contract low of $426,997 to $571,114. On contract 7 (superstructure) five bids were received, ranging from the contract low of $1,135,964 to $1,494,962.

LOW BIDDERS: (Contract 4)

1. McCarthy Improvement Co., Davenport, Iowa (contract)	$426,997
2. C. E. Carson, Chicago	473,508
3. Power-Thompson, Joliet, Ill.	533,738

LOW BIDDERS: (Contract 7)

1. American Bridge Co., Chicago (contract)	$1,135,964
2. Bethlehem Steel Co., Bethlehem, Pa.	1,379,995
3. R. C. Mahon & Co., Detroit	1,423,950

CONTRACT No. 4

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Bases & piers	5,230 c. y.	$19.10	$23.50	$27.00
2. Conc. above tops & bases of piers	5,630 c. y.	17.16	15.50	27.00
3. Reinf. misc. metal	165,000 lb.	.06	.06	.045
4. Steel found. piles	1,312,000 lb.	.037	.044	.039
5. Conc. bent 8–23, abutments, retaining wall	3,600 c. y.	18.00	19.50	23.80
6. Conc. pav. and curbs	2,650 c. y.	12.00	15.00	10.50
7. Reinf. & misc. metal in conc. of items 5 & 6	356,000 lb.	.05	.0425	.045
8. Found. piles, conc. or steel, bents 8–23	8,200 l. f.	2.50	2.80	2.20
9. Found. piles of creo. timber, abut. and retaining wall	2,300 l. f.	1.50	1.40	1.20
10. Sand and gravel embank. fill in entrance plazas	14,000 c. y.	.50	1.25	.90
11. Cut stone for entrance plazas	L.S.	11,000.00	16,250.00	7,000.00
12. Storm water drainage system in R. I.	L.S.	5,000.00	4,000.00	4,000.00
13. Storm water drainage system in Davenport	L.S.	9,200.00	5,600.00	5,000.00
14. Asph. on conc. base in street in Davenport	1,000 s. y.	1.50	1.10	3.00

CONTRACT No. 7

	Quan.	Unit Prices (1)	(2)	(3)
1. Metal work (silicon, carbon, alloys, castings, etc.)	17,300,000 lb.	$0.056	$0.0682	$0.071
2. Conc. on river bridge & viaduct span	4,670 c. y.	16.00	20.00	20.00
3. Reinf. in conc. of item 2.	1,495,000 lb.	.0444	.053	.05
4. Tool houses and locker houses	L.S.	6,080.00	6,500.00	7,500.000
5. Complete elec. sys. for entire project	L.S.	19,986.00	21,000.00	20,000.00

GILA PROJECT, ARIZONA

OWNER: U. S. Bureau of Reclamation; L. J. Foster, construction engineer.

PROJECT: Construction of Fortuna spillway at Station 948.00, and bridges at Station 876.75 and Station 987.12, gravity main canal, Gila project, Ariz. The work is located about 10 miles east of Yuma. Spillway is used to lead water from the side of the canal to the Gila River. First bridge is a 94-ft. three-span timber farm bridge crossing the canal at a skew. Second bridge is a three-span 91-ft. timber highway bridge. Contractor is to begin work within 30 days of receipt of notice to proceed, and is to complete the work within 450 calendar days from such receipt. Government will furnish cement; sand and broken rock or gravel for use in concrete; admixtures if required for use in concrete; cement and sand for use in mortar and grout; and other materials not supplied by the contractor which become a permanent part of the structure.

BIDS: Six bids were received Mar. 1, 1939, ranging from $58,857 to $84,833. Minimum labor rates are as follows: skilled, $1.10 per hr.; semi-skilled, 70¢ per hr.; common, 62½¢ per hr.

LOW BIDDERS:

1. Norman I. Fadel, Los Angeles	$58,857
2. Parish Bros., Hollywood, Calif.	60,146
3. Winston Bros. Co., Los Angeles	65,669

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Excav. common, for canal and spillway channel and roughing out excav. for struc	172,100 c. y.	$0.11	$0.20	$0.13
2. Excav. rock for canal and spillway channel and roughing out excav. for struc	3,500 c. y.	1.00	0.05	0.60
3. Excav. common, for struct	3,000 c. y.	0.60	0.50	0.60
4. Compacted subbase	240 c. y.	2.00	0.75	1.80
5. Backfill about struct	2,000 c. y.	0.15	0.25	0.20
6. Compacted backfill about struct	2,000 c. y.	1.00	0.30	1.00
7. Concrete in struct	850 c. y.	22.00	13.50	28.00
8. Placing reinf	141,000 lb.	0.02	0.01	0.02
9. Install. rubber water stops	175 l. f.	0.50	0.50	0.30
10. Install. elastic jointfiller material	285 s. f.	0.50	0.25	0.40
11. Dry-rock paving	200 s. y.	2.50	1.00	3.00
12. Riprap	2,000 c. y.	1.50	0.90	0.65
13. Const. reverse filters	55 c. y.	5.00	2.00	5.00
14. Driving sheet steel piling	22,840 lb.	0.02	0.0325	0.025
15. Driving timber piles	1,010 l. f.	1.00	1.00	1.10
16. Erecting untr. timber in bridges	16 M.b.m.	35.00	35.00	40.00
17. Erecting timber in bridges	38 M.b.m.	35.00	40.00	55.00
18. Bit. wearing surf. on bridge floor	345 s. y.	0.50	0.02	3.00
19. Const. timber railings	1 M.b.m.	60.00	80.00	70.00
20. Install. radial gates	10,000 lb.	0.04	0.02	.04
21. Install. radial-gate hoist and gate operating and control mechanisms	21,000 lb.	0.04	0.02	.04
22. Placing bit. material in float drums	200 cwt.	1.50	2.00	1.50
23. Install. cast-iron pipe in reverse filters and between weir-well inlets and weir wells	12,000 lb.	0.05	0.015	0.045
24. Install. pipe handrails	770 lb.	0.10	0.02	0.10
25. Install. metal stop-plank guides	4,100 lb.	0.10	0.02	0.035
26. Install. elec. conduits and conductors	L.S.	150.00	300.00	75.00

PIER, NEW YORK

OWNER: City of New York; commissioner of docks in charge.

PROJECT: Removal of structure of old pier 26 and removal of inshore portions of pier and shed of old pier 25, to be replaced by a new pier 26 with its adjacent platforms; 350 days are allowed for completion.

BIDS: Seven bids were received Jan. 25, 1939, ranging from the contract low of $576,550 to $689,384.

LOW BIDDERS:

1. J. Richard Steers, Inc., New York (contract)	$576,550
2. Allen W. Spooner & Son, Inc., New York	598,544
3. Spearin Preston & Burrows, Inc., New York	612,000

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Remov. struct. old Pier 26 and inshore part of Pier 25	L.S.	$54,000.00	$55,362.00	$68,000.00
2. Dredge and dispose	50,000 c. y.	.63	.65	.90
3. Deposit riprap and fill	16,000 c. y.	1.80	1.60	2.50
4. Deposit riprap and fill	5,500 c. y.	.50	.16	1.00
5. New pier 26 and platforms	L.S.	459,500.00	484,202.00	453,500.00

WATER MAIN, MICHIGAN

OWNER: City of Bay City, Mich.; Ayres, Lewis, Norris and May, engineers.

PROJECT: Water main extension project located on North Henry St. at Michigan Central Railroad tracks. Stipulated contract time is 80 days. Minimum labor rates are as follows: skilled, 80c. per hr.; semi-skilled, 70c. per hr.; common, 60c. per hr.

BIDS: Nine bids were received Nov. 8, 1938, ranging from $7,878 to $14,907. Contract was awarded to the Leonard Construction Co., Saginaw, Mich. (low bidder). Unit prices, to be applied in the event additions to or deductions from work to be performed under the contract arise, were submitted by the low bidder as follows: 36-in. cast iron main in place, $21.88 per lineal foot; concrete sidewalk removed and replaced, 18 c. per sq. yd.; pavement removed and replaced, $4.50 per lineal foot of main.